Developmental Shift of Parsing Strategies:
Processing Empty Subject Sentences among L1 and L2 Learners

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Abstract

In this thesis, I proposed a “Developmental Shift of Parsing Strategies (DSPS)” hypothesis, which states that the choice of parsing (sentence processing) strategies is parallel to language development. In order to clarify the process of “developmental shift” among L1 and L2 learners of different languages, a series of psycholinguistic experiments were conducted.

In Chapter 1, I reviewed the experimental literature for the processing of empty subject sentences in English, Japanese and Chinese, and presented the theoretical incompatibility between the “Perceptual strategy” and “Transparency hypothesis”.

The Most Recent Filler Strategy (MRFS) is proposed for processing empty subject sentences in English. This strategy is a kind of “Perceptual strategy”, which is used during the delay of verb control information. Experiments in Japanese empty subject processing did not test the delay of verb control information, but only verified MRFS. Since the matrix verb is located at the end of a sentence in Japanese, control information does not exist when MRFS applies. Although experimental findings on Chinese suggest that the control information of verbs is utilized immediately, whether MRFS exists or not cannot be verified, since the control information of a verb is used immediately before MRFS applies. Therefore, it is necessary to verify whether MRFS really works in a situation where control information is unavailable, i.e., when the meaning of the verb is not fully understood by a hearer (reader). This could happen in two groups of people, children (L1) and foreign language (L2) learners who have not yet learned the meaning of the verbs. Since they lack the information from the matrix verb, they have to “guess” the meaning of the given sentence. The main concern of this thesis lies in identifying the kinds of strategies that are utilized in this “guessing”. And more importantly, this thesis clarifies how these strategies for “parsing” change after these people have acquired the full meaning of the given verbs.
Chapter 2 introduced an experiment from the perspective of Chinese-speaking school children. The first graders preferred using the “Recency strategy” to fill the empty subject. Both linguistic and non-linguistic strategies are utilized in a mixed way in the middle grades. The fifth graders used the control information on the verb to process the sentences.

Chapter 3 discussed an experiment conducted on Japanese-speaking school children. The first graders utilized “Perceptual strategies” to “guess” empty subject sentences. The effect of the case-marker *ga* becomes prominent among the second graders. Strategies for empty subject processing becomes more complex and mixed in the third and fourth grades. In the fifth grade, “subject preference” effect becomes prominent.

Chapter 4 introduced an experiment from the perspective of English native speakers learning Chinese. The results show that a general-purpose strategy was used at an earlier stage, followed by a mixture of a general-purpose strategy and linguistic strategy at an intermediate stage, and a linguistic strategy based on verb information at the later stage of L2 learning.

Chapter 5 introduced an experiment conducted on English native speakers learning Japanese. A mixture of a general-purpose strategy and a linguistic strategy making use of the case-marker *ni* was used by beginners. These strategies shift to a strategy using the case-marker *ga* and a general-purpose strategy at the intermediate stage, and subsequently to the “subject preference” strategy at the advanced level.

In short, at least two types of strategies, namely non-linguistic strategies (or general strategies) and linguistic strategies (or language-specific strategies), are employed in parsing. The aforementioned experiments also suggest that parsing strategy shifts from non-linguistic to linguistic ones via a stage of mixture between both strategies. The results of children (L1) and second language (L2) learners are shown below.
This thesis has succeeded in making contributions to clarify some aspects of the shift from “guessing” to “parsing” strategies through a number of psycholinguistic experiments.
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Any error in this thesis is the sole responsibility of me, the author of the thesis.
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Introduction

Parsing (sentence processing) research in psycholinguistics has progressed with a strong influence from Generative Grammar. The direction of Generative Grammar research has experienced radical changes in the due course of its development, and has had a great impact on parsing research. The development of parsing research can be roughly divided into three stages according to its relation with Generative Grammar (cf. Sakamoto 1998). The three stages are respectively called as follows: i) parsing according to the “Derivational Theory of Complexity, DTC” in the 1960’s; ii) parsing by the “Perceptual strategy” in the 1970’s, and iii) parsing based on the “Transparency hypothesis” after the 1980’s.

The DTC hypothesizes that the process of sentence operation proposed by Generative Grammar is identical to that of the mental sentence processing of the parser. That is, the parsing mechanism is directly related to the grammar. In the 1960’s, “Phrase Structure Rules” and “Transformational Rules” were assumed in “Standard Theory” of the earliest stage of Generative Grammar. According to the DTC hypothesis, the complexity of parsing should increase with the increase in structural complexity assumed in the Generative Grammar. In other words, sentences with more transformational rules should be more complex in parsing. However, the hypothesis failed to explain the discrepancies between parsing time and the grammatical structure suggested by results from psychological experiments. The research of DTC hit a dead end (cf. Hirose 2004, Pritchett & Whitman 1995, Sakamoto 1996, 1998).

In the 1970’s, as a remedy to the DTC, the “Perceptual strategy” was proposed to avoid direct relation to the grammar. In the “Perceptual strategy” account, the role of grammar is minimal in parsing. It is an attempt to explain the parsing mechanism by solely using general cognitive knowledge. The implication of this view is that the study of parsing mechanism
reveals nothing about the human linguistic system. If this is correct, the organization of linguistic knowledge will not be understood no matter how the study of sentence parsing advances. As the most radical extreme, the advocates of this view claim that there is no human knowledge specific to language.

The "Perceptual strategy" is too radical in that the parser disregards all linguistic information in parsing. In response to the "Perceptual strategy", the "Transparency hypothesis" was proposed in the 1980's. This hypothesis admits that there is language-specific knowledge, and suggests that the relation between grammar and parser is transparent. According to this hypothesis, the characteristics of linguistic knowledge are observable through the study of the parser.

As discussed above, the research on DTC hit the end with the transition in Generative Grammar. However, the stances of the latter two theories, i.e., "Perceptual strategy" (that the parser utilizes cognitive, general knowledge) and "Transparency hypothesis" (that the parser utilizes language-specific knowledge) remain unclear. It can be the case that one of them is completely disregarded by the parser. However, it is also possible that both are correct, as the two are compatible to some extent. More in-depth research is required to examine this possibility.

In the present study, I propose a "Developmental Shift of Parsing Strategies (DSPS)" hypothesis, which states that the choice of parsing strategies is parallel to language development. The strategy to be adopted by the parser shifts from a "Perceptual strategy" to a "Linguistic strategy" along with the development of linguistic knowledge. In a word, a general-purpose strategy such as a "Perceptual strategy" is dominant in an earlier stage of language development. After one acquires sufficient linguistic knowledge, however, the "Language-specific strategy" becomes dominant. That is, the development of parsing strategy shifts from non-linguistic
The DSPS hypothesis is natural and plausible. It is natural to assume that the parser uses as much available information as possible. However, it is necessary to notice the following two points: i) when linguistic information is not available, the parser who acquires sufficient linguistic knowledge also uses the “Perceptual strategy”. The two types of strategy are better considered as two possible candidates being used by the parser. That is to say, the parser does not use a fixed strategy in parsing. It is appropriate to think that more than one strategy co-exist in parsing; ii) the purpose of this thesis is to find out at which stage and in what manner linguistic information is used, and what linguistic information is to be used, during the shift of strategies.

In order to clarify the process of the “developmental shift” of parsing strategies, it requires a more detailed investigation on the parser. A parser processes a string of linguistic elements that are continuously given along the temporal sequence, and understands the information transmitted by the given string. The parser identifies each component, establishes the relationship between the components, and determines the meaning of the entire string. Research has been conducted to shed light on the mechanism of the parser (cf. Aoshima et al. 2004, Inoue & Fodor 1995, Sakamoto 1998). In the psycholinguistic literature, the question of what kind of information guides the initial parsing decision has been the focus. One of the factors is the effect of lexical information (Ford et al. 1982, MacDonald et al. 1994, Miyamoto 2002, Trueswell & Tanenhaus 1994). The use of lexical information has been supported by considerable empirical studies in psycholinguistics (Aoshima et al. 2004, Boland et al. 1990, Inoue & Fodor 1995, Kamide & Mitchell 1999, Miyamoto 2002). In order to test the effect of lexical information, it is necessary to utilize an adequate sentence structure. “Control structure” will be exploited in the present study.
There is a kind of lexical information called "control information", which determines how a particular verb influences the interpretation of the subject of infinitival (and gerundive) complements. Consider the following examples adapted from Chomsky (1981).

(1)  
   a. John promised Bill [PRO₁ to feed himself].  
   b. *Mary promised Bill [PRO₁ to feed himself].

(2)  
   a. John persuaded Bill [PRO₁ to feed himself].  
   b. *John persuaded Mary [PRO₁ to feed himself].

In (1a), the subject of the verb promise is assumed to be the understood subject of the infinitival clause, while in (2a) the object of the verb persuade is considered the understood subject of the infinitival clause. At the subject position of the infinitival clause, Chomsky (1981) posits the empty category PRO, which is an abstract syntactic element with no phonetic content. PRO must establish a relationship with an antecedent in order to acquire its meaning. This coreference is determined by a relationship called "control". When PRO appears in an infinitival complement clause, one of the arguments in the matrix clause must be understood as its antecedent (controller). Whether the controller is the subject or the object of the matrix clause depends on the intrinsic lexical properties of that verb. The ungrammatical versions (1b) and (2b) show clearly that promise is a subject control verb and persuade is an object control verb.

The study of PRO is interesting for several reasons. Firstly, it lacks phonological realization, and therefore is not subject to physical perception. Secondly, it does not involve a moved element (NP-trace or wh-trace), so readers have no warning of the empty element downstream in the sentence. Finally, PRO needs to be linked to an antecedent. These special

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1 If there is no structurally appropriate antecedent NP, then PRO will have an arbitrary reference.
features of PRO provide an attractive structure to test predictions made by different syntactic processing models. Nonetheless, the empirical evidence on how readers resolve PRO on-line is far from conclusive (Betancort et al. 2005). Currently, related experiments have only been conducted on a limited number of languages, such as English, Japanese and Chinese, and the experimental methods and data are inadequate. There is much room for more in-depth research.

Two views have been proposed in previous studies on the processing of empty subject (PRO) sentences. "Recency strategy", which is a kind of "Perceptual strategy", suggests that a parser fills the gap with the nearest filler (cf. Frazier et al. 1983). On the other hand, "Transparency hypothesis" suggests that a parser fills the gap by referring to some linguistic clue (cf. Sakamoto 1995, 1996, 2002).

Current theories and models of parsing were mainly based on adult monolingual speakers. The lack of the data of child first language (L1) acquisition and adult second language (L2) acquisition may have an impact on some of the core issues in parsing, such as the universality of parsing mechanisms and processing modularity. The data from child L1 and adult L2 parsing behavior may provide new ideas or additional support for existing models of parsing. Moreover, parsing data from child L1 and adult L2 learners may also provide information on theories and models of language acquisition, potentially shedding light on issues such as the role of parsing in grammatical development, or whether there is a critical period for language acquisition.

If the DSPS hypothesis is correct, it is basically expected to show a common shift in parsing strategy across different languages. This hypothesis assumes that speakers who have acquired more linguistic knowledge utilize more linguistic information than perceptual information both in L1 acquisition and L2 acquisition. If empirical data from typologically different languages show the same trend, the DSPS hypothesis can be considered a universal hypothesis. I will show that there is a shift from "Perceptual strategies" to "Linguistic
strategies" in both L1 and L2 acquisition. The aim of the present study is to clarify the process of "developmental shift" among L1 and L2 learners of different languages.

This thesis is divided into six chapters. In Chapter 1, I will review experimental studies on the processing of empty subject sentences in English, Japanese and Chinese. I will also provide a detailed comparison of the "Perceptual strategy" and "Transparency hypothesis" for subsequent discussion. The participants of experiments in Chapter 1 are adult monolingual speakers, and I will move to child L1 and adult L2 learners in the following chapters. Chapters 2 and 3 introduce a series of experiments conducted on Chinese and Japanese school children respectively, which serve to compare the choice of strategies at different stages of L1 acquisition. In order to clarify the DSPS hypothesis, it is also interesting to see how L2 learning influences the choice of parsing strategies. Chapter 4 discusses an experiment conducted on English native speakers who were learning Chinese. Chapter 5 discusses an experiment conducted on English native speakers who were learning Japanese. Chapter 6 compares the results obtained from these experiments, and discusses the types of parsing strategies that could explain these findings.
Chapter 1: Previous Studies

In the present study, I utilized empty subject sentences to verify the “Developmental Shift of Parsing Strategies (DSPS)” hypothesis.

Firstly, I will tackle some theoretical issues of empty subject sentences in English, Japanese and Chinese (section 1.1). English and Chinese have no case-marking particles, and the verb appears ahead of the empty subject. In contrast to English and Chinese, Japanese uses case-marking particles, and the verb appears after the empty subject. On the other hand, Chinese can be made to follow the Japanese OSV word order, with the use of the preposition dui. There are common features and differences between English, Japanese and Chinese. How do these influence empty subject sentence processing?

Next, I will turn to the discussion on parsing (sentence processing). There are two types of strategies in parsing; namely “Perceptual strategies” (where cognitive and general knowledge is utilized) and “Linguistic strategies” (where language-specific knowledge is utilized). There is an on-going argument as to whether “Perceptual strategies” and “Linguistic strategies” are involved in the parsing stage. Evidence for both sides of the argument will be presented. I will first present the “Perceptual strategy” view, which posits that non-linguistic strategy is the major strategy employed by the parser (section 1.2.1). Then, I will introduce the “Transparency hypothesis”, which states that linguistic information is available and is utilized in the due course of parsing (section 1.2.2, 1.2.3).

1.1 Theoretical issues of empty subject sentences

In this section, I will briefly introduce some theoretical issues concerning empty subject constructions. The theoretical characterization of the empty subject has not reached a conclusive
solution. The purpose of this section is to survey the various viewpoints on empty subjects.

1.1.1 Empty subject sentence in English

Here is a construction that is called a "control sentence" in English, as shown below.

(3) a. John promised Mary to go to Beijing.
   b. John persuaded Mary to go to Beijing.

Despite the apparent similarity in their structures, the person going to Beijing is John in (3a), and Mary in (3b). The difference is attributed to the empty subject [__ to go to Beijing] in the infinitival clauses. The matrix verb promise in (3a) postulates that the subject John will be the empty subject in the infinitival clause, while the matrix verb persuade in (3b) requires the object Mary to be the empty subject in the infinitival clause. In the framework of the Government and Binding (GB) theory, an empty category (represented as PRO) is assumed in the subject position of infinitival clauses. (3) could be represented as follows.

(4) a. John₁ promised Mary₂ [PRO₁ to go to Beijing].
   b. John₁ persuaded Mary₂ [PRO₁ to go to Beijing].

The properties of PRO have been the focus of many theoretical linguistic research works. One major proposal by Chomsky (1981, 1982) suggests that the combination of [+anaphoric] and [+pronominal] features yields four different types of empty categories: PRO, pro, anaphor and variable. PRO is identified as a [+anaphoric, +pronominal] empty category, pro is identified as a [-anaphoric, +pronominal] empty category, anaphor is identified as a [+anaphoric,
-pronominal] empty category, and variable is identified as a [-anaphoric, -pronominal] empty category.

Since empty categories share the same syntactic features with overt NPs, both overt NPs and empty categories should obey the same “Binding Principles” (5).

(5) Principles of the Theory of Binding (= Chomsky 1982, (17))

A. An anaphor is bound in its governing category.
B. A pronominal is free in its governing category.
C. An R-expression is free.

As an empty category with [+anaphoric] and [+pronominal] features, PRO is subject to both Principles A and B of “Binding Theory”. If both of these are to apply to a given instance of PRO, a contradiction arises, since “Principle A” requires PRO to be bound locally, and “Principle B” requires it to be free in the same domain. Therefore PRO can only be found in positions where the notion of governing category is not defined, i.e., in ungoverned positions. In this way, no contradiction arises under the “Binding Theory”. This result is known as the “PRO Theorem”.

However, PRO in the GB theory is incompatible with minimalist assumptions. PRO is to be understood in terms of syntactic movement within minimalism. The movement theory of control claims that PRO is a copy and that obligatory control arises from movement (Boeckx & Hornstein 2003, 2004, 2006, Hornstein 1999, 2001, 2003). Here, I will introduce Hornstein’s (1999) view.
1.1.1.1 Hornstein 1999

Control has been distinguished from raising in the GB theory. Raising is the product of movement operations, while control is the result of construal processes that relate a PRO to an antecedent. In the GB theory, control sentences like (6a) have structures like (6b). These contrast with raising sentences shown in (7).

(6)  
   a. John expects to leave.
   b. John₁ expects [PRO₁ to leave].

(7)  
   a. John seemed to win.
   b. John₁ seemed [trace₁ to win].

Departing from this standard approach, Hornstein (1999) offers a minimalist account to explain the structure of (6). This is achieved by reducing certain cases of control to movement. The structure in (8) is built up through the application of Merge and Move operations.

(8)  
   a. [VP John leave]
      ('John' merges with 'leave'; checking the verb's θ-role)
   b. [IP John to [VP John leave]]
      (merge VP with 'to'; raise 'John' to [Spec, IP])
   c. [VP John [expects [IP John to [VP John leave]]]]
      (merge IP with 'expect'; raise 'John' to [Spec, VP])
   d. [IP John₁ [VP John₁ [expects [IP John₁ to [VP John₁ leave]]]]]
      (merge VP with I; raise 'John' to [Spec, IP])

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Note that all the lower instances of ‘John’ in (3d) are absent in PF. Thus, Hornstein (1999) proposes that control structures are formed from movement, similar to raising. Hornstein’s (1999) theory eliminates certain formal syntactic devices, but retains the syntactic character of control in that an empty argument is syntactically bound to the controlling antecedent.

1.1.2 Empty subject sentence in Japanese

Empty subject sentences are also found in Japanese.

(9) a. Taro1-ga Hanako2-ri [PRO1 Tokyo iki]-o hakuyoosita.  
    Taro-Nom Hanako-Dat Tokyo going-Acc confessed
    ‘Taro confessed to Hanako that he would go to Tokyo.’

b. Taro1-ga Hanako2-ri [PRO2 Tokyo iki]-o meireisita.  
    Taro-Nom Hanako-Dat Tokyo going-Acc ordered
    ‘Taro ordered Hanako, (saying) she would go to Tokyo.’

It is controversial as to whether or not the PRO exists in nominals. Williams (1985) argues against postulating an empty subject in NPs. He proposes the “implicit argument” view. Roeper (1987) calls Williams’ (1985) approach a “lexical approach”, which associates implicit arguments with properties of the verb. Roeper (1987) argues that the “implicit argument” is syntactically realized as PRO. Furthermore, Abney (1987) proposes a “DP-analysis”, arguing...

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2 The movement theory of control has been criticized by Culicover & Jackendoff (2001), Landau (2000, 2003), Sigurðsson (1991, 2003). Landau (2003) and Sigurðsson (2003), based on the Icelandic case agreement facts, claim that obligatory control should not be collapsed with raising, since control and raising are different.
that there is a PRO subject of DP based on Theta-theory\(^3\).

It is also controversial how sentences in (9) and (10) should be analyzed. In contrast to (9), in which PRO appears in a gerund clause, PRO appears in a tensed clause in (10).

   Taro-Nom Hanako-Dat Tokyo-Loc go fact-Acc confessed
   ‘Taro confessed to Hanako that he would go to Tokyo.’

   Taro-Nom Hanako-Dat Tokyo-Loc go fact-Acc ordered
   ‘Taro ordered Hanako, (saying) she would go to Tokyo.’

There is a tense marker "-u" (ik-u 'go') in (10), which signals that this is a case where the empty subject appears in the tensed clause. Huang (1984, 1989) suggests that an empty subject in a tenseless subordinate clause is PRO, while that in the tensed clause is pro or variable. In contrast, according to Hasegawa (1984-85), Japanese has PRO in both tensed and tenseless subordinate clauses. On the other hand, Hoji (1988), Whitman (1987), Fiengo & Haruna (1987) either do not make a distinction between PRO and pro or deny their existence as empty pronominals.

### 1.1.3 Empty subject sentence in Chinese

There are various viewpoints as to whether there is PRO in Chinese. Even if the viewpoint of Chomsky or Huang is accepted, the infinitive form is a necessary condition for PRO to exist in Chinese. Huang (1989) suggests that there is a fairly systematic distinction

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\(^3\) See Sakamoto (1996) for a more detailed discussion.
between finite and non-finite clauses in Chinese. That is, if any element of the AUX category (such as an aspect marker or a modal verb) occurs in the clause, it is said to be a finite clause. Otherwise, it is a non-finite clause. This distinction is shown in (11) and (12).

(11) a. Zhangsan shuo [pro lai le].
    Zhangsan say come ASP
    ‘Zhangsan said that (he) came.’

b. Zhangsan xiangxin [pro hui lai].
    Zhangsan believe will come
    ‘Zhangsan believes that (he) will come.’

(12) a. Zhangsan1 dui Lisi2 tanbai shuo [PRO1 qu Beijing].
    Zhangsan to Lisi confess that go Beijing
    ‘Zhangsan confessed to Lisi that he would go to Beijing.’

b. Zhangsan1 dui Lisi2 quangao shuo [PRO2 qu Beijing].
    Zhangsan to Lisi advise that go Beijing
    ‘Zhangsan advised Lisi to go to Beijing.’

According to Huang (1989), since the aspect marker “le” and modal verb “hui (will)” occur in (11a) and (11b) respectively, the clauses are considered to be finite and the empty subject will be pro. On the other hand, since none of the AUX categories occurs in the clause (12) “qu Beijing (go to Beijing)”, the clause is considered a non-finite clause and the empty subject will be PRO.

On the other hand, Xu (1986) posits a totally new class of empty categories that is
fundamentally different from those defined in Chomsky (1981, 1982). After showing that empty
categories in Chinese do not behave exactly like Chomsky’s (1981, 1982) variable, NP-trace,
PRO nor pro, he suggests that they may be identified as all of the four types as a whole, as
instances of the “Free Empty Category”. The “Free Empty Category” is an “all-inclusive empty
category” with no specified features, “characterized by their complete freedom of
referentiality”.

1.1.4 Summary

I have introduced different viewpoints on empty subjects in English, Japanese and
Chinese. The characteristics of empty subjects are still unclear. There were heated arguments in
the 1980’s on whether PRO can be analyzed as pro or variable. Later on, it became an issue on
whether PRO is the same as raising in the 1990’s. Furthermore, the feature of PRO has become
an interesting issue since the 2000’s, with the advancement of the minimalist framework.

The syntactic property of empty subjects is a matter of theoretical concern. However, note
that in (4), (9), (10), (12), the interpretation of the sentence depends on how the agent of the
embedded event should be identified. That is, we are interested in “how” the empty subject
sentence is interpreted. In the following section, then, I will turn to empirical studies on the
processing of empty subject sentences.

1.2 Processing of empty subject sentences

One of the central objectives of psycholinguistic research is to clarify the mechanism of
 parsing when a “gap” is filled with a “filler”. There were two major proposals in previous
studies. One is the “Recency strategy”, a “Perceptual strategy” which suggests that a parser fills
the gap with the nearest filler (cf. Frazier et al. 1983). The other is the “Transparency
hypothesis", in which a parser fills the gap by referring to some linguistic clues (cf. Sakamoto 1996). Here, I will introduce the processing of empty subject sentences in English, Japanese and Chinese.

1.2.1 English empty subject sentence processing

"Perceptual strategy" refers to the heuristics employed by the parser that makes decision based mostly on surface information and avoids direct utilization of the properties of the grammar. Right association (Kimball 1973), minimal attachment (Frazier & Fodor 1978), Most Recent Filler Strategy (MRFS) (Frazier et al. 1983) and Dependency locality theory (Gibson 2000) are some prominent examples of "Perceptual strategies". Here, I will present the MRFS, which is directly related to empty subject sentence processing.

1.2.1.1 Most Recent Filler Strategy (Frazier et al. 1983)

The lexical representation of a word, especially a verb, offers considerable information to the reader or the listener how that word is syntactically and semantically related to other words in the sentence. (Marsten-Wilson et al. 1988, Tanenhaus et al. 1989, Tyler 1989, Hemforth et al. 1997). However, there is no agreement on when and how lexical representations are used. It is argued that there are cases where the use of lexical information is delayed. That is, the initial syntactic decisions are made without reference to the lexical information (Frazier et al. 1983, Frazier 1987, 1989, Mitchell 1987). On the other hand, some researchers argue that lexical information is used immediately, and lexical information provides relatively seamless communication among parsing, discourse context, etc. (Tyler 1989, Hemforth et al. 1997).

As discussed in introduction, there is a kind of lexical information called "control information", which determines how a particular verb influences the interpretation of the subject
of infinitival (and gerundive) complements. Here, examples (1) and (2) are repeated below.

(13)  
  a. John promised Bill [PRO₁ to feed himself].  
  b. *Mary promised Bill [PRO₁ to feed himself].

(14)  
  a. John persuaded Bill [PRO₁ to feed himself].  
  b. *John persuaded Mary [PRO₁ to feed himself].

In (13a) the subject of the verb *promise is assumed to be the understood subject of the infinitival clause, while in (14a) the object of the verb *persuade is considered the understood subject of the infinitival clause. The ungrammatical versions (13b) and (14b) show clearly that *promise is a subject control verb and *persuade is an object control verb. I will refer to (13a) as a subject control sentence, and (14a) as an object control sentence.

Verbs that do not allow an object before the infinitive, like *start in (15a), are always subject control verbs when an infinitival (or gerundive) clause follows. Verbs that allow a direct object before an infinitive clause, such as *force in (15b), are always object control verbs, with the exception of only a few transitive verbs, such as *promise.

(15)  
  a. The little child started _____₁ to sing.
  b. The little child forced the woman _____₁ to sing.

Most control verbs have unambiguous control properties. However, it is possible for a verb to instantiate either subject or object control depending on the context. *Beg is an example of verbs with ambiguous control properties. This property is illustrated in (16): *Beg is used as a subject control verb in (16a), and an object control verb in (16b).
(16) a. The little child begged _____ to sing for the woman

b. The little child begged the woman _____ to sing

Frazier et al. (1983) employed a speeded comprehension task to examine the strategy used by the parser to identify the antecedent of the subordinate empty subject in English control structures. In each trial, a sentence is visually presented to the readers in a word-by-word manner. After the presentation of the sentence, the participants were asked to make a sentence-final “got it” or “missed it” decision. Experimental sentences such as (17) to (20) were manipulated according to the type of the main verb (subject vs. object control) and the ambiguity of the sentences with respect to the verb control information (ambiguous control vs. unambiguous control).

(17) Recent filler (subject control), unambiguous
Everyone liked the woman who the little child started [PRO to sing those stupid French songs for trace last Christmas].

(18) Distant filler (object control), unambiguous
Everyone liked the woman who the little child forced trace [PRO to sing those stupid French songs last Christmas].

(19) Recent filler (subject control), ambiguous
Everyone liked the woman who the little child begged [PRO to sing those stupid French songs for trace last Christmas].

(20) Distant filler (object control), ambiguous
Everyone liked the woman who the little child begged trace [PRO to sing those stupid French songs last Christmas].
The reaction times were faster in conditions (17) and (19) than conditions (18) and (20). In the recent filler unambiguous sentence (17), the verb *start*, a subject control verb, indicates that its subject *the little child* is the controller of PRO. Notice that among the two fillers, *the woman* and *the little child*, the latter is closer to the empty subject PRO. Hence, the more recent filler is the actual filler. In the distant filler unambiguous sentence (18), the verb *force*, an object control verb, assigns its object *the woman* as the controller of PRO. Here, the correct filler is further away from the other filler. Frazier *et al.* (1983) hypothesize that recency is a factor in identifying the antecedent, so that the recent filler is preferred over the distant one. It follows from their predictions that the sentences in which the recent filler is also the actual filler will produce faster reaction times in a “got it” comprehension task. This effect is explained by the MRFS, which is stated as follows:

(21) Most Recent Filler Strategy (Frazier *et al.* 1983:196):

During language comprehension a detected gap is initially and quickly taken to be co-indexed with the most recent potential filler.

When unambiguous sentences were processed, control information on the verb cannot be fixed just like ambiguous sentences, since both ambiguous and unambiguous sentences yield the same result. It is claimed that MRFS applies when verb control information is absent. In such cases, recency strategy assigns the nearest potential filler to PRO. This initial choice by the parser is subsequently checked against the control information. It is this error-correcting procedure that causes the longer processing time in the distant filler sentences. Furthermore, if *trace* is a possible filler, there should be no difference in the reaction time between conditions (17) and (18), because *trace* is the nearest filler for PRO in (18). Hence, Frazier *et al.* (1983)
assume that the parser does not recognize *trace* as a possible filler for PRO. In other words, the parser does not recognize a gap as filler for another gap⁴.

Frazier *et al.* (1983) suggest that verb control information is temporarily disregarded. During this delay, the nearest lexical antecedent is given priority to fill the empty subject in English empty subject sentence processing. In a word, Frazier *et al.* (1983) made the following three assumptions for English.

(22)  
\[ \begin{align*}  
\text{a.} & \quad \text{Control information of the verb is delayed in parsing.} \\
\text{b.} & \quad \text{MRFS applies during the delay.} \\
\text{c.} & \quad \text{The parser does not allow an empty category to be the antecedent for PRO.} 
\end{align*} \]

Assumption (22a) admits that the parser ignores available grammatical information. Since both ambiguous and unambiguous sentences yield the same result, then when unambiguous sentences were processed, control information on the verb cannot be fixed just like ambiguous sentences. Frazier *et al.* (1983) assume that the control information on the verb is disregarded. The delay of verb control information is unexpected, since the parser is supposed to use possible information as quickly as they can. Frazier *et al.* (1983) did not say anything about why the control information of the verb was disregarded. Probably, the difficulty of the experimental sentences, or the memory capacity of the participants have caused the delay of verb control information. Assumption (22c) is not discussed but tacitly presupposed by Frazier *et al.* (1983). This assumption leads to the claim that *trace* (in (18) and (20)) is disregarded. If assumption (22b) is correct, the parser should prefer a recency strategy. Frazier *et al.* (1983) propose that MRFS is a guiding heuristic covering the assignment of dependencies between lexically

---

⁴ This is termed the “Lexical Filler Only” hypothesis in Sakamoto (1995, 1996).
specified phrases and phonetically null positions. They further suggest that this strategy might be generalized as a "salience" strategy, where recency is simply the most powerful variable affecting salience. This strategy is based on the detective heuristics that the parser uses the surface information, i.e., the distance between the filler and PRO in linear order. Therefore, MRFS is a general strategy that is based on distance measurement. When filler-gap dependency exists, the choice of filler is resolved by a "Perceptual strategy".

1.2.1.2 Discussions of MRFS

MRFS has a strong influence on psycholinguistics. There have been continuous discussions on MRFS.

Crain & Fodor (1985) conducted an experiment by using wh-questions to test MRFS. They conclude that there is a garden-path effect at the late gap position only in ambiguous Distant Filler questions, not in the unambiguous ones. They argue that MRFS exists only in ambiguous sentences to resolve the ambiguous relation when the grammar fails to process the relation between fillers and gaps.

Ford & Dalrymple (1988) argue that it is not tenable to claim that ambiguous and unambiguous cases are treated in the same way, and that there are no grounds for claiming that verb control information is delayed. Instead, Ford & Dalrymple (1988) point out that all of Frazier et al.'s (1983) Recent Filler sentences are subject control cases. They claim that the subject control form of verbs is preferred over the non-subject control form. They suggest that a sentence that contains a non-subject control, unambiguous matrix verb (e.g., force) will be taken as passive in order to achieve a subject control interpretation. This causes the difficulty of force-type sentences at the end of the sentence.

Fodor (1988) argues that even if some linguistic information is delayed, there are various
possibilities concerning what kind of information is delayed. Five possible interpretations were proposed by Fodor (1988): i) delay of subcategorization information; ii) delay of case; iii) delay of Theta Theory Principles; iv) delay of Principles of Government; v) delay of Control Information.

Nicol (1988) did not test Frazier et al.'s (1983) hypothesis that the control information of a verb is delayed. However, she proposes that the assignment of the antecedent for PRO need not occur immediately, and states “immediate reactivation of the correct antecedent for trace, delayed reactivation of all previously mentioned referents for PRO”. Then, Nicol (1988) claimed that the parser does not need MRFS.

However, Frazier et al. (1983) claim that MRFS is a very general strategy, and “there is linguistic evidence for the existence of a strategy of assigning the most recent filler to a gap” (Frazier et al. 1983, p.194). The clearest evidence is the fact that many languages place special restrictions on intersecting filler-gap dependencies as in (23a), but not on nested filler-gap dependencies as in (23b).

\[
(23) \begin{array}{c}
\text{a. FILLER}_1 \quad \text{FILLER}_2 \quad \text{GAP}_1 \quad \text{GAP}_2 \\
\text{b. FILLER}_1 \quad \text{FILLER}_2 \quad \text{GAP}_2 \quad \text{GAP}_1 
\end{array}
\]

Frazier et al. (1983) also claim that “developmental evidence exists for a strategy akin to the strategy of assigning the most recent filler to a gap” (Frazier et al. 1983, p.195). Chomsky (1969) has shown that young children misinterpret Bill in (24a), the most recent lexical noun phrase, as the subject of grab, following the Minimum Distance Principle, in which the noun
phrase nearest to the complement verb is interpreted as its subject. Minimum Distance Principle does correctly characterize the control properties of most verbs in English, just like (24b).

(24)  
a. John promised Bill to grab the jewels.  
b. John told Bill to grab the jewels.

1.2.1.3 Summary

I have introduced MRFS, an example of a “Perceptual strategy” that avoids the direct use of grammatical information. “Perceptual strategy” refers to a strategy employed by the parser, which makes decision based on surface clue such as numbers, distance, and position. It is defined as a general-purpose, non-linguistic strategy where only general cognitive knowledge is used in the processing of a sentence.

If “Perceptual strategy” is a general strategy, it will be observed in other languages. In the next sections, I will discuss empty subject sentence processing in Japanese and Chinese. In Japanese, assumption (22a) of MRFS (Control information of the verb is delayed in parsing) can be tested independently, as the verb carrying control information is located at the end of the sentence. Furthermore, the language has a relatively free word order, which allows the recency effect to be examined. In Chinese, the verb appears before the empty subject, which allows the delay of verb control information to be tested. Moreover, by rearranging sentences into OSV word order with the use of preposition dui, the recency effect can also be tested.

1.2.2 Japanese empty subject sentence processing

“Perceptual strategy”, which separates parsing from linguistic knowledge, explains the process of parsing by using more general cognitive concepts, e.g., position or number. In

Sakamoto (1995, 1996, 2002), Oda et al. (1997), and Ninose et al. (1998) conducted a series of experiments on empty subject sentence processing in Japanese. Here, I will discuss the studies of Oda et al. (1997) and Ninose et al. (1998), which made use of recognition tasks in their experiments.

1.2.2.1 Oda et al. 1997

Oda et al. (1997) used the experimental sentences in (25) to examine the real-time processing of empty subject sentences in Japanese. A sentence was presented to one ear of a participant, and after the onset of the sentence, a possible antecedent for the empty subject was presented to the other ear. There were 6 test points, each with a 300msec interval. The participants were asked whether or not the given antecedent would really go to Tokyo, by pressing the “YES” key or “NO” key as quickly as possible. Here, I introduce the comparison between the reaction times of the Subject control sentences and Object control sentences in the case of “YES” responses at 0msec (i.e., right after the end of presentation of the sentence).
The mean reaction time of subject control sentences such as (25a) was significantly faster than object control sentences like (25b). As for the percentage of Consistency Score (i.e., the percentage of subject control responses given a subject control sentence and that of object control responses given an object control sentence), subject control sentences (25a) have higher consistency scores than object control sentences (25b), although the difference is not big enough to reach a statistically significant level. Moreover, subject control sentences have a significantly faster reaction time than object control sentences. Oda et al. (1997) conclude that the results show a “subject preference” effect: the grammatical subject is preferred as the candidate for the empty subject.

These results suggest that the parser prefers the subject as a possible antecedent. The subject might be the preferred antecedent because it has the grammatical function as a ‘subject’.
However, this may not be the only possible way to explain the results because the subject is the first noun phrase at the beginning of a sentence. It is plausible that what the parser prefers as a possible antecedent for the empty subject is indeed the first noun phrase, since it is at the beginning of the sentence. In general, the one that exists in the sentence beginning is said that prominence is high. This effect is called “Primacy effect”. The following section introduces an experiment that resolves this issue.

1.2.2.2 Ninose et al. 1998

In order to examine the word order effect, Ninose et al. (1998) conducted an experiment employing the same procedure as that of Oda et al. (1997), except that the order of the subject and object in the sentence was reversed. The experimental sentences are shown in (26). The results showed that the reaction times for subject control sentences such as (26a) were significantly faster than object control sentences like (26b). Subject control sentences had a significantly higher consistency score than object control sentences.

(26) a. Subject control

Junko2-ni   kinoo   Tosio1-ga  trace2  [PRO1 Tokyo iki]-o
    Junko-DAT    yesterday    Tosio-NOM      Tokyo  going-ACC

    tegami-de   hakuzyooosita.
    letter-by    confessed

d. Object control

Junko2-ni   kinoo   Tosio1-ga  trace2  [PRO2 Tokyo iki]-o
    Junko-DAT    yesterday    Tosio-NOM      Tokyo  going-ACC

    tegami-de   meireisita.
    letter-by    ordered
The findings show that "subject preference" exists even when the order of the subject and object in the matrix clause is scrambled. Thus, as the results of the two recognition experiments indicate, regardless of the scrambling of word order, the participants tend to prefer the matrix clause subject as a possible antecedent for the empty subject.

1.2.2.3 Summary

In the processing of Japanese empty subject sentences, the parser prefers the use of the grammatical subject to fill the gap in recognition tasks (Oda et al. 1997, Ninose et al. 1998). This shows that MRFS does not apply to Japanese. That is, how the parser fills the gap does not rely on the linear distance between the gap and the filler. Instead, the grammar (i.e., case) has a significant role in the processing of filler-gap dependency. The parser, when processing a head-final language such as Japanese, utilizes case information available from case-marking particles attached to an NP before encountering the final verb. The parser builds up the prediction based on the information from the NP. When the matrix verb is input, the control information of the matrix verb is used to check whether this prediction is satisfied. This provides extra support to the fact that the relationship between the parser and the mental grammar is transparent.

1.2.3 Chinese empty subject sentence processing

In English and Japanese empty subject sentence processing, different results have been obtained. To reexamine the results of English and Japanese empty subject sentence processing, Zhai (2006) conducted an experiment with Chinese empty subject sentences (i.e., dui-construction⁵). The experimental sentences are shown in (27).

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⁵ Refer to Appendix A for a more detailed description of Chinese dui-constructions.
(27) a. **SOV order, Subject control sentence**

Shangzhou / Xiaodong1 / zaixinzhong / du Xiaohong2 / zhencheng / tanbai shuo /
last week Xiaodong in letter to Xiaohong seriously confess that

\[ \text{P7} \quad \text{P8} \quad \text{P9} \quad \text{P10} \]

[biye hou / cong Changchun / zhijie / PRO1 qu Beijing.]
after graduate from Changchun immediately go Beijing

‘Last week Xiaodong confessed to Xiaohong seriously in a letter that he would go to
Beijing from Changchun immediately after graduating.’

b. **SOV order, Object control sentence**

Shangzhou / Xiaodong1 / zaixinzhong / du Xiaohong2 / zhencheng / quangao shuo/
last week Xiaodong in letter to Xiaohong seriously counsel that

\[ \text{P7} \quad \text{P8} \quad \text{P9} \quad \text{P10} \]

[biye hou / cong Changchun / zhijie / PRO2 qu Beijing.]
after graduate from Changchun immediately go Beijing

‘Last week Xiaodong (seriously) counseled Xiaohong to go to Beijing from
Changchun immediately after graduating in a letter.’

c. **OSV order, Subject control sentence**

dui Xiaohong / Shangzhou / Xiaodong1 / zaixinzhong / zhencheng / tanbai shuo/
to Xiaohong last week Xiaodong in letter seriously confess that

\[ \text{P7} \quad \text{P8} \quad \text{P9} \quad \text{P10} \]

[biye hou / cong Changchun / zhijie / PRO1 qu Beijing.]
after graduate from Changchun immediately go Beijing

d. **OSV order, Object control sentence**

dui Xiaohong / Shangzhou / Xiaodong1 / zaixinzhong / zhencheng / quangao shuo/
to Xiaohong last week Xiaodong in letter seriously counsel that

\[ \text{P7} \quad \text{P8} \quad \text{P9} \quad \text{P10} \]

[biye hou / cong Changchun / zhijie / PRO2 qu Beijing]
after graduate from Changchun immediately go Beijing

The reading times (RTs) of P6 (verb + шuo) for subject control sentences was shorter than that for the object control sentences in both SOV word order and OSV word order, and the difference was significant. From the difference of the RTs, Zhai (2006) assumes that the parser is undergoing some kind of processing at the time when P6 is input.

No significant difference in the RTs of P10 (qu Beijing 'go to Beijing') between each condition was observed in this experiment. Therefore, Zhai (2006) claims that the empty subject has already been filled before the complement sentence verb P10 is input, and the empty subject is filled by the information from the matrix verb P6 that exists in the experiment sentence. In other words, control information on the matrix verb P6 is used immediately.

1.3 Conclusion

This chapter described some issues on the empty subject, in respect of theories and empty subject sentence processing experiments. There are considerably different opinions with respect to the members of the empty subject inventory. One of the earliest formulation is Chomsky’s (1981, 1982) ‘PRO Theorem’. ‘PRO Theorem’ attributes strange properties to PRO. It is defined as a category that is both [+anaphoric] and [+pronominal]. Thus, it has to be both bound and free in its governing category. Since the two requirements are logically mutually exclusive, it follows that PRO should have no governing category. As PRO has to be ungoverned, it cannot carry case and cannot have an overt phonological form. In view of the problematic aspects of the PRO theory, PRO is suggested to be pro, variable, a form of raising etc. in newer proposals.

Despite the disputes in the theoretical characterization of empty categories, it is commonly accepted that the empty subject in complement clauses must be identified. Two ideas
have been proposed in previous studies on the processing of empty subject sentences. One is the “Recency strategy” (i.e., MRFS), by which a parser fills the gap with the nearest filler. The other is the “Transparency hypothesis”, which suggests that a parser fills the gap by referring to some linguistic clue.

Frazier et al. (1983) claim that the “Recency strategy” is a general strategy, and provide evidence to support the hypothesis. They further suggest that it is a cross-linguistic tendency. However, the results from the processing of Japanese and Chinese empty subject sentence did not support the “Recency strategy”. The parser of Japanese and Chinese follows the “Transparency hypothesis”, as shown by the “subject preference” effect in Japanese, and “the immediate use of verb control information” in Chinese, which emerges when the parser attempts to fill the gap.

Note that MRFS is used during the delay of verb control information. Frazier et al. (1983) assumed the delay of verb control information, without providing a clear justification. The delay of verb control information has been discussed in the literature but no conclusion has been reached. Crain & Fodor (1985) argue that MRFS does exist but only for ambiguous cases, while Nicol (1988) claims that the parser does not need MRFS. Ford & Dalrymple (1988) argue that it remains inconclusive from the experimental data that the control information is delayed. Fodor (1988) argues that even if some linguistic information is delayed, there are different possibilities concerning what kind of information is delayed.

Delay of verb control information is an untested assumption. Oda et al. (1997) and Ninose et al. (1998) did not test the delay of verb control information, but only verified MRFS by using Japanese in which the verb is located at the end of sentence. Although Zhai (2006) claims that the control information of a verb is utilized immediately, it only denied (22a) (Control information of the verb is delayed in parsing). With regard to (22b), however, whether
MRFS exists or not cannot be verified using Chinese. That is, since control information of the verb is used before MRFS, it cannot be used to verify whether MRFS works. Therefore, it is necessary to verify whether MRFS really works in the situation where verb control information is not available, i.e., when the meaning of the verb is not fully understood by the reader. This could happen in two groups of people, children (L1) and foreign language (L2) learners who have not yet learned the meaning of the verb.

The question is which strategy the parser will utilize to “guess” the meaning of a sentence when the meaning of a verb is not understood. The present thesis is an attempt to clarify what clues are utilized by the parser when the verb does not provide sufficient hints, and what strategies, if any, are used to “guess” the meaning of a sentence. Forced choice judgment tasks require the participants to give YES/NO responses even when they do not know the answer. If no strategy is employed at all, i.e., judgments are made randomly, the number of YES and NO responses will be about the same.

What is more interesting is that “guessing” changes into “processing” when the control information of a verb has been acquired. In a word, there is a shift from “guessing” to “parsing”.

In the next chapter, I will describe experiments conducted on children who are Chinese native speakers to investigate the shift from “guessing” to “parsing”.
Chapter 2: Processing empty subject sentences among Chinese children

In Chapter 1, I introduced English, Japanese, and Chinese empty subject sentence processing experiments for adults. In English, the Most Recent Filler Strategy (MRFS) is claimed to be used during the delay of verb control information. In Japanese, the delay of verb control information cannot be verified, since the verb appears at the end of the sentence, and only MRFS has been verified. In Chinese, though the result supports that the control information of a verb is not delayed, it is unable to verify whether MRFS works, since the control information of a verb is used before MRFS. Therefore, it is necessary to test the conditions in which control information of the verb cannot be used, so that the applicability of MRFS can be verified.

The condition I have put forth is that “the verb is present, but the meaning of it is not understood”. Both child L1 and adult L2 learners would probably encounter this situation. The parser does not understand the meaning of the verb. When the participants are forced to answer questions, what strategy will be used? How do they “guess” the sentence meaning? How do the “guessing” strategies change in course of linguistic knowledge acquisition?

In this chapter, I will discuss an experiment conducted from the aspect of L1 development. Participants from elementary school (first graders to fifth graders) were recruited for the off-line and on-line experiments. I propose that due to the difference in level of linguistic knowledge, children at different ages will employ different strategies to process empty subject sentences. The use of recency and linguistic strategies would therefore be reflected from the results in different age groups. The organization of this chapter is as follows: section 2.1 describes several theoretical perspectives about language acquisition and word learning. In section 2.2, I present an empty subject sentence experiment conducted on elementary school students, and propose
the “Developmental Shift of Parsing Strategies (DSPS)” hypothesis. Section 2.3 concludes the chapter by bringing out the implications of the reported difference across age-groups, and clarifies the process from “guessing” to “processing”.

2.1 Language Acquisition

Several theoretical perspectives have been proposed in order to explain how children acquire a language. In this section, I will introduce Skinner’s (1957) *Verbal Behavior*, Chomsky’s (1959) review of *Verbal Behavior*, Piaget’s (1970) view and Chomsky’s (1976) view which argues that it is impossible to isolate language from cognitive development.

2.1.1 Skinner’s (1957) view

The first view that language acquisition should be seen as a conditioning process was described in great detail in Skinner’s (1957) *Verbal Behavior*. The large part of *Verbal Behavior* is not concerned with how children learn their native language, but with adult language. However, Skinner’s (1957) *Verbal Behavior* is best known for its discussion on language acquisition.

Skinner (1957) claims that children learn language as a result of reinforcements provided by their parents. Reinforcements serve to ‘shape’ their initially incorrect utterances, so that these utterances eventually become adult-like. Skinner even pointed out that language is made up of ‘units’ which can then be ‘composed’ into new combinations. Skinner (1957) focused more on discussing environmental influences on the child rather than what might be going on in the child’s brain.

It is probably fair to say that Skinner (1957) did not have a suitable model for the nature of linguistic knowledge. He did not highlight the essentially productive or creative nature of
language. Thus his attempt to explain language acquisition was unsuccessful because it did not satisfactorily account for children's rapid acquisition of the skills required to produce and understand any sentence in a language.

2.1.2 Chomsky's (1959) view

In a critique to *Verbal Behavior*, Chomsky (1959) argued that language is creative. If children do learn a language as a result of the reinforcement provided by their parents as Skinner (1957) proposed, then it is a problem when parents do not normally give their children systematic linguistic instruction. In addition, what children listen to contains incomplete or ungrammatical sentences most of the time. Therefore, a child has to master a complex linguistic system on the basis of incomplete and inaccurate information. Since almost all children do acquire a language completely, some innate mechanism must exist in children's brain. According to Chomsky (1959), children are born with specific linguistic skills and specific linguistic knowledge, and these enable them to acquire a language. This knowledge is referred to as Universal Grammar.

Chomsky (1959) argued that language can be described as a set of rules, and that the child's task is to discover what these rules are. Chomsky (1959) proposed that the child is able to do this by generating his own rules as a result of listening to and analyzing the speech he hears around him. The child can then try out these rules by producing his own sentences using the rules he has worked out. Initially the child's rules will be very simple and general, and although these rules will often produce 'correct' utterances, they will also result in utterances which an adult would never use. With time, the child modifies and adds on to the set of rules he is using, until he finally produces adult-like speech.

As discussed above, the suggestion that children seek to discover the rules of the language
they are learning is just like a process of hypothesis testing, and some kind of complex problem solving. Essentially, rules are tested and revised many times. However, Chomsky (1959) claimed that the processes which operate during language acquisition are unique in that they cannot operate without innate knowledge about the nature of language. Moreover, Chomsky (1959) argued that if a child had to work through all possible hypotheses, language acquisition could not possibly take place as rapidly and inevitably as it does. Thus Chomsky (1959) made strong claims that language is pre-programmed, and is acquired as the result of maturation rather than learning.

2.1.3 Piaget's (1970) view

Piaget (1970) argues that child language appears neither as the result of conditioning process nor as the result of maturation of an innate neurophysiology program, but instead through the completion of the processes involved in sensori-motor development. Piaget (1970) claims that it is impossible to isolate language from cognitive development. Piaget (1970) points out that once language begins, children's ability to describe the world is greatly increased. Piaget (1970) emphasized that language is only part of a much wider ability to act symbolically, for at the same time as children begin to use language they also begin to draw, to imitate previously observed actions, and to use symbolic plays. For Piaget (1970), language is only possible after the capacity for symbolic action and symbolic representation has developed. Thus the development of new cognitive processes is a prerequisite for the acquisition of new aspects of language.

2.1.4 Chomsky's (1976) view

Chomsky (1976) admitted that the relation between the language faculty and cognitive
capacity remains to be discovered. Even though still taking the view that there is an autonomous
cognitive system capable of generating linguistic rules, Chomsky (1976) admitted that language
may result only from the interaction of several mental faculties, one being the faculty of
language. Chomsky (1976) concluded that "there may be no concrete specimens of which we
can say, these are solely the product of the language faculty, and no specific acts that result
solely from the exercise of linguistics functions" (Chomsky 1976, p.43).

Chomsky (1976) has considered this argument particularly in the context of naming
things. Chomsky (1976) argued that there is probably no sharp distinction between the
properties of a named object or person which are strictly linguistic, and those which form part of
common-sense understanding. For example, the word 'tiger' only has meaning if we draw on
general knowledge of tigers and call up non-linguistic information about their shape, size, color
and behavior. Linguistic knowledge may provide information about more abstract semantic
properties like male/female or human/non-human, but in order to produce or understand
sentences, both kinds of information are needed. In this way, the knowledge held in our
linguistic system is used hand-in-hand with our non-linguistic knowledge. Thus Chomsky
(1976) claimed that the 'language faculty' does not operate in isolation from other cognitive
processes that organize and store information about the world.

2.1.5 Summary

Skinner (1957) proposed that children learned language as a result of the reinforcements
provided by their parents, while Chomsky (1959, 1976) claimed that language acquisition is the
result of maturation of an innate neurophysiology program. Contrary to both, Piaget (1970)
claimed that it is impossible to isolate language from cognitive development.

Here, I adopt a stance that language acquisition is related to these three points. The
The language that children hear from their parents is input to the Language Acquisition Device as language materials. The kernel part of the Language Acquisition Device is Universal Grammar, which acts as an innate neurophysiology program. With the influence of cognitive development, language materials are output as the adult grammar.

During the last decade, developmental psychologists have become increasingly aware that human infants have an impressive store of conceptual knowledge (e.g., Gelman 1990, Keil 1994, Mandler 1988, Spelke 1994). Children learn words rapidly (see Bloom 2000). Moreover, their advances in word learning and conceptual development are intertwined from the very beginning (see Booth et al. 2005). These advances are fueled by perceptual and associative capacities which permit infants to discover linguistic units (including syllables, words and phrases) as well as relevant conceptual units (including individual objects, object categories, object properties, actions and relations involving objects), and then calibrate the relations between them (e.g., Gomez & Maye 2005, Quinn & Johnson 2000, Younger 1990).

As for the cognitive developmental period, the following four are assumed by Piaget (1970): i) sensori-motor period (0-1.5, 2 years old); ii) preoperational period (2-7 years old); iii) concrete operational period (7-11, 12 years old); iv) formal operational period (11, 12 years old). As discussed above, it is not appropriate to isolate language from cognitive development. Similarly, it is also not appropriate to isolate parsing (sentence processing) from cognitive
development. The cognitive ability develops with the increase in age. Thus, it is interesting to know what changes take place in parsing across different ages when cognitive ability progresses.

In the following sections, I verify and compare the parsing strategies employed at different ages, by using empty subject sentences in Chinese.

2.2 Experiments

It is very interesting to investigate how parsing mechanism works at different stages of language acquisition, and what difference it makes before and after the verbs in the experimental sentences have been acquired. I conducted an off-line experiment and an on-line experiment to clarify the “guessing” and “parsing” mechanisms at different stages of children’s vocabulary acquisition.

2.2.1 Off-line Experiment

An off-line experiment was conducted to test the participants’ knowledge on Chinese verbs. This is to make sure that the level of acquisition of the verbs used in the experiment is well-controlled.

Eighteen subject control verbs and eighteen object control verbs were selected from a Chinese language textbook used in Harbin, China (see Appendix B). Two hundred participants (forty participants from each grade) participated in this off-line experiment. The average age of first graders is six years and eleven months (range: 6.5-7.7), and the standard deviation is 3.6. There are 19 boys, and 21 girls. The average age of second graders is seven years and eleven months (range: 7.4-8.8), and the standard deviation is 4.6. There are 23 boys and 17 girls. The average age of third graders is eight years and eleven months (range: 8.7-9.5), and the standard
deviation is 2.7. There are 16 boys and 24 girls. The average age of fourth graders is ten years and one month (range: 9.6-10.7), and the standard deviation is 3.1. There are 18 boys, and 22 girls. The average age of fifth graders is eleven years and one month (range: 10.5-11.8), and the standard deviation is 3.6. There are 16 boys, and 24 girls.

Table 2-1: The participants in off-line experiment

<table>
<thead>
<tr>
<th>Grade</th>
<th>male : female</th>
<th>the average age (range)</th>
<th>standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>First grade</td>
<td>19:21</td>
<td>6.11 (6.5-7.7)</td>
<td>3.6</td>
</tr>
<tr>
<td>Second grade</td>
<td>23:17</td>
<td>7.11 (7.4-8.3)</td>
<td>4.6</td>
</tr>
<tr>
<td>Third grade</td>
<td>16:24</td>
<td>8.11 (8.7-9.5)</td>
<td>2.7</td>
</tr>
<tr>
<td>Fourth grade</td>
<td>18:22</td>
<td>10.1 (9.6-10.7)</td>
<td>3.1</td>
</tr>
<tr>
<td>Fifth grade</td>
<td>16:24</td>
<td>11.1 (10.5-11.8)</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Participants were asked to fill in a questionnaire which asked the participants whether they knew the word or not for each of the thirty-six verbs. Fourteen subject control verbs and fourteen object control verbs were selected according to the verb acquisition rate. The words were selected with the purpose of controlling the amount of verbs known by each participant group. The first graders knew none of the selected verbs, third graders knew exactly half of the verbs and fifth graders knew all the selected verbs.

All other words used in the experimental sentences were selected from a Chinese language textbook used in kindergartens. The children in Harbin have to receive education for at least one year before they enter elementary school. Thus, the only difference between first grades and fifth graders is whether they knew the matrix verbs or not.
2.2.2 On-line Experiment

2.2.2.1 Experimental Design

The following empty subject sentences were used as experimental sentences to investigate how the “guessing” and “parsing” mechanisms work, and what changes there would be before and after the matrix verb is acquired. All participants had already acquired the words used in the experimental sentences, except the matrix verbs.

(29) a. **SOV order, Subject Control sentence**

\[
\begin{array}{ccccccc}
\text{P1} & \text{P2} & \text{P3} & \text{P4} & \text{P5} & \text{P6} \\
\text{亮亮} & / & \text{对} & \text{丽丽} & / & \text{发誓} & \text{说} & [\text{today} & \text{认真} & \text{PRO1} & \text{做} & \text{作业}] & .
\end{array}
\]

Liangliang (male) to Lili (female) swear that today seriously do homework

‘Liangliang swore to Lili that today he will do homework seriously.’

[Question sentence] 亮亮 今天 认真 做 作业。

Liangliang jintian renzhen zuo zuoye

‘Liangliang will do homework seriously today.’

b. **SOV order, Object Control sentence**

\[
\begin{array}{ccccccc}
\text{P1} & \text{P2} & \text{P3} & \text{P4} & \text{P5} & \text{P6} \\
\text{亮亮} & / & \text{对} & \text{丽丽} & / & \text{嘱咐} & \text{说} & [\text{today} & \text{认真} & \text{PRO2} & \text{做} & \text{作业}] & .
\end{array}
\]

Liangliang (male) to Lili (female) say that today seriously do homework

‘Liangliang will do homework seriously today.’

\[
\text{Simpson & Wu (2002) claim that “frequently this occurs when a language has serial verb constructions which allow for a sequence of two verbs of communication to be reanalyzed as a sequence of verb + complementizer (p.75)”. Schematically as in (i):}
\]

(i) \text{Verb1 Verb2 } \rightarrow \text{Verb1 Complementizer}
Liangliang (male) to Lili (female) persuade that today seriously do homework

'Liangliang persuaded Lili that today she will do homework seriously.'

[Question sentence] Lili today seriously do homework

'Lili will do homework seriously today.'

c. OSV order, Subject control sentence

dui Lili / l i a n g l i a n g / fa shi shuo [jintian renzhen PRO zuo zuoye].
to Lili (female) Liangliang (male) swear that today seriously do homework

'To Lili, Liangliang swore that today he will do homework seriously.'

[Question sentence] Liangliang today seriously do homework

'Liangliang will do homework seriously today.'

d. OSV order, Object Control sentence

dui Lili / l i a n g l i a n g / zhufu shuo [jintian renzhen PRO zuo zuoye].
to Lili (female) Liangliang (male) persuade that today seriously do homework

'To Lili, Liangliang persuaded that today she will do homework seriously.'

[Question sentence] Lili today seriously do homework

'Lili will do homework seriously today.'
'Lili will do homework seriously today.'

The matrix verb *fashi* 'swear' in (29a, c) is a subject control verb while the matrix verb *zhufu* 'persuade' in (29b, d) is an object control verb. (29a, b) take the 'subject – object' word order, and (29c, d) take the 'object – subject' word order. Thus, the experiment design was 2 (verb types) × 2 (word orders). The complement sentence verbs, e.g., *zuo* 'do', were found in the textbook for first graders.

Twenty-eight pairs of experimental sentences like (29), each consisted of four conditions (SOV order vs. OSV order; subject control vs. object control) were constructed, which made a total of one hundred twelve sentences. The Latin square method was adopted in this experiment. The one hundred twelve experimental sentences were divided into four lists, such that only one condition from each pair was presented to each participant. Each list consisted of seventy sentences, including twenty-eight experimental sentences, twenty-eight filler sentences, six warm-up sentences and eight practice sentences (see Appendix C). These sentences were presented in a random order, except the warm-up sentences and practice sentences.

2.2.2.2 Apparatus and Procedure

Sixty participants (twelve participants in each grade) participated in this experiment. All participants were native Chinese-speaking children with normal or corrected eye-sight. The average age of first graders is six years and eleven months (range: 6.5-7.8), and the standard deviation is 4.6. There are 5 boys and 7 girls. The average age of second graders is eight years and one month (range: 7.7-8.6), and the standard deviation is 3.3. There are 6 boys and 6 girls. The average age of third graders is eight years and eleven months (range: 8.5-9.5), and the standard deviation is 4.0. There are 6 boys and 6 girls. The average age of fourth graders is nine
years and eleven months (range: 9.7-10.4), and the standard deviation is 2.2. There are 6 boys and 6 girls. The average age of fifth graders is eleven years and one month (range: 10.7-11.7), and the standard deviation is 3.8. There are 6 boys and 6 girls.

Table 2-2: The participants in on-line experiment

<table>
<thead>
<tr>
<th>Grade</th>
<th>male : female</th>
<th>the average age (range)</th>
<th>standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>First grade</td>
<td>5:7</td>
<td>6.11 (6.5-7.8)</td>
<td>4.6</td>
</tr>
<tr>
<td>Second grade</td>
<td>6:6</td>
<td>8.1 (7.7-8.6)</td>
<td>3.3</td>
</tr>
<tr>
<td>Third grade</td>
<td>6:6</td>
<td>8.11 (8.5-9.5)</td>
<td>4.0</td>
</tr>
<tr>
<td>Fourth grade</td>
<td>6:6</td>
<td>9.11 (9.7-10.4)</td>
<td>2.2</td>
</tr>
<tr>
<td>Fifth grade</td>
<td>6:6</td>
<td>11.1 (10.7-11.7)</td>
<td>3.8</td>
</tr>
</tbody>
</table>

The experiment was conducted with SuperLab 2.0 running on a CX/835LS dynabook notebook computer. Each trial consisted of two parts, namely the self-paced reading task and the comprehension task. In the self-paced reading task, participants were asked to read sentences in a moving window. The sentences were chunked into phrases\(^7\). One phrase was displayed at each time. Participants were instructed to press Q on a standard keyboard at the beginning of each trial. A ‘★’ sign signaled the beginning of a sentence. Participants were told to press space key immediately after they had finished reading the text on the screen. Once the key was pressed, the moving window would move rightward, so that the previous chunk would disappear from the screen and the next chunk would show up. All sentences ended with a full stop mark (。).

\(^7\) Chunks may consist of different units, such as “word”, “preposition + noun”, “verb + complementizer”. Here, I refer to them as “phrase” collectively.
The comprehension task would start once the full stop mark was read. A YES/NO question about the sentence, like “Liangliang will do homework seriously today.” for a subject control sentence and “Lili will do homework seriously today.” for an object control sentence, was displayed in the middle of the screen. Each subject control sentence was followed by a “correct” sentence in which the subject of the control sentence is the subject of the question sentence. In the same way, each object control sentence was followed by a “correct” sentence in which the object of the control sentence is the object of the question sentence. However, the first graders do not know which one is the “correct” answer, since they have not acquired the meaning of control verbs. They have to “guess” whether the answer is correct or not by some strategies. Otherwise, they would answer at random. Participants were instructed to respond to the question using either the YES or NO key.

The number of YES responses and NO responses was calculated for each question sentence. The response pattern of YES (judgment as correct in a correct sentence) and NO (judgment as wrong in a wrong sentence) is different. In the YES responses, only one correct positive evidence supports the YES answer, whereas it is necessary to check all the negative possibilities in the NO responses. Thus, NO responses will require more time and will be less accurate than the YES responses (cf. Carpenter & Just 1975). Therefore, we assume that the YES responses support clearly what the participants selected, e.g., having answered the question “Liangliang will do homework seriously today.” as YES clearly supports Liangliang (henceforth “NP1”) preference. On the other hand, NO response means a kind of “rejection”. For example, a NO response to the question “Lili will do homework seriously today.” indicates that the participants have rejected Lili (henceforth “NP2”) as a possible answer to the preceding empty

Because the complement sentence verbs used in the experimental sentences were verbs that the lower grades also have already acquired, I assume the participants could answer the question sentence.
subject sentence. This NP2-rejection leads to the two possible interpretations: NP1 (Liangliang) or a third party (other than NP1 and NP2). Since the rejection of NP2 includes NP1 interpretation, it might support NP1 preference indirectly and secondarily. That is, the YES responses to NP1/NP2 support NP1/NP2 preference directly, whereas NO responses to NP1/NP2 support NP2/NP1 preference indirectly and secondarily.

Next, I will discuss the results within the same word order (i.e., SOV and OSV) condition. The two word orders are discussed separately, mainly because the nearest noun phrase (filler) to the empty subject differs in the two word orders.

2.2.2.3  **SOV word order**

2.2.2.3.1  **Prediction**

Unacquired verbs

From the result of the off-line experiment, it is known that the first graders had not acquired the experimental verbs. Therefore, control information of the verb could not be used. How are first graders going to answer the questions without using the control information? If no strategy is employed at all, i.e., judgments are made randomly, the difference between the number of YES and NO responses to the question “Liangliang will do homework seriously today.” would not be significant. The difference between the number of YES and NO responses to the question “Lili will do homework seriously today.” would also be insignificant.

Of course, various possibilities are available with regard to the insignificant difference: the children do not use any strategies completely, or some competing strategies are used randomly; strategies used may differ due to individual variations, or depending on the experimental sentences. Therefore, I will study the overall data, but not the data of individuals. If the result turns out to be not significant, there are two possibilities: the participants do not use
any strategies completely, or some competing strategies are used randomly.

If first graders employ some strategies to “guess” the sentence, the “guess” should not be done by the use of information on the verb, the only means is to use the information from the nouns.

i): Perceptual strategy – recency strategy

If first graders use the recency strategy, by which the nearest filler to PRO is preferred to fill the PRO, there would be more YES responses to the question “Lili will do homework seriously today.” than the question “Liangliang will do homework seriously today.”, because NP2 (Lili) is the nearest filler to PRO. On the other hand, there would be more NO responses to the question “Liangliang will do homework seriously.” than the question “Lili will do homework seriously.”, since NP1 (Liangliang) is the further filler than NP2 (Lili) to PRO.

ii): Perceptual strategy – primacy strategy

If first graders utilize the primacy strategy, by which the filler at the beginning of the sentence is preferred to fill the empty subject, there would be more YES responses to the question “Liangliang will do homework seriously today.” than the question “Lili will do homework seriously today.”, because NP1 (Liangliang) is at the beginning of the sentence. Moreover, there would be more NO responses to the question “Lili will do homework seriously today.” than the question “Liangliang will do homework seriously today.”, since NP2 (Lili) is not at the beginning of the sentence.

iii): Linguistic strategy – the verb shuo

The children in the first grade knew all the words except the matrix verbs according to the
results of the off-line experiment. Since the first graders lacked knowledge about the matrix verb, they would not be able to tell the difference between subject control sentences and the object control sentences. When "v-shuo" is input, first graders would analyze "shuo" as the matrix verb (say), because they had not acquired the matrix verb. If "shuo" is the matrix verb, the agent of the action of saying would be the subject (Liangliang). We would expect there to be more YES responses to the question "Liangliang will do homework seriously today." than the question "Lili will do homework seriously today.", because NP1 (Liangliang) is the subject of the sentence. Moreover, we would expect there to be more NO responses to the question "Lili will do homework seriously today." than the question "Liangliang will do homework seriously today.", since NP2 (Lili) is the object of the sentence.

iv): Linguistic strategy – the preposition dui

There is another possibility that first graders might prefer to fill the empty subject with NP2 (Lili), because the preposition dui before NP2 (Lili) made NP2 (Lili) prominent. We would expect there to be more YES responses to the question "Lili will do homework seriously today." than the question "Liangliang will do homework seriously today.", because the preposition dui appears before NP2 (Lili). Moreover, there would be more NO responses to the question "Liangliang will do homework seriously today." than the question "Lili will do homework seriously today.", since the preposition dui does not appear before NP1 (Liangliang).

Summary

Recency strategy and primacy strategy are "Perceptual strategies", while the use of information from the verb shuo and the preposition dui are "Linguistic strategies". The predictions of unacquired verbs are shown below.
Table 2-3: Predictions of answers for the unacquired verbs in SOV order at first grade

<table>
<thead>
<tr>
<th>no strategy employed</th>
<th>YES responses = NO responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>some strategies employed</td>
<td>perceptual strategies recency strategy</td>
</tr>
<tr>
<td></td>
<td>YES NP1 (Liangliang) &lt; YES NP2 (Lili)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Liangliang) &gt; NO NP2 (Lili)</td>
</tr>
<tr>
<td></td>
<td>primacy strategy</td>
</tr>
<tr>
<td></td>
<td>YES NP1 (Liangliang) &gt; YES NP2 (Lili)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Liangliang) &lt; NO NP2 (Lili)</td>
</tr>
<tr>
<td>linguistic strategies</td>
<td>the verb shuo</td>
</tr>
<tr>
<td></td>
<td>YES NP1 (Liangliang) &gt; YES NP2 (Lili)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Liangliang) &lt; NO NP2 (Lili)</td>
</tr>
<tr>
<td></td>
<td>the preposition dui</td>
</tr>
<tr>
<td></td>
<td>YES NP1 (Liangliang) &lt; YES NP2 (Lili)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Liangliang) &gt; NO NP2 (Lili)</td>
</tr>
</tbody>
</table>

**Acquired verbs**

The children in the fifth grade had already acquired control information of the experimental verbs (ｆashi, zhufu) according to the results of the off-line experiment. In this case, the control information of the verbs is available, so they should be able to judge the question correctly. “Linguistic strategies” like “an empty subject is filled by referring to the control information of the experimental verb” are expected to be used just like the adult.

If fifth graders fill the empty subject by referring to the control information of the matrix verbs, there should not be any significant difference between mean reading times (RTs) of P6 (zuo zuoye ‘do homework’), since the agent of the complement clause should have already been identified at the time when P6 is shown on the screen. On the other hand, when the matrix verb P3 (fashi, zhufu) is input, the RTs of the subject control verb (fashi) should be shorter than the object control verb (zhufu), provided that the fifth graders processed sentences as
sophisticatedly as adults. The predictions of the fifth graders are shown below.

**Table 2-4: Predictions of RTs and correct answer for the acquired verbs in SOV order at fifth grade**

<table>
<thead>
<tr>
<th>RTs of P3</th>
<th>(29a) &lt; (29b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTs of P6</td>
<td>(29a) = (29b)</td>
</tr>
<tr>
<td>Percentage of correct answers</td>
<td>high</td>
</tr>
</tbody>
</table>

Since the participants of the off-line experiment were different from those of the on-line experiment, acquired and unacquired verbs for each grade from second grade to fourth grade were not known. Thus, the prediction is similar to the first graders when the second, third and fourth graders “guess” the sentences including the unacquired verbs, and the prediction is the same as fifth graders when they “process” the sentences including the acquired verbs.

2.2.2.3.2 Results and discussion

In this section, I will introduce how the strategy changes with different level of verb acquisition in SOV word order.

First grade

The results of first graders in SOV word order are shown below.
Table 2-5: Questions and YES/NO responses in first grade for SOV order

<table>
<thead>
<tr>
<th>Subject NP of question sentence</th>
<th>YES (26%)</th>
<th>NO (74%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, distant filler)</td>
<td>22</td>
<td>62</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, recent filler, preposition dui)</td>
<td>36</td>
<td>48</td>
<td>84</td>
</tr>
<tr>
<td>Total</td>
<td>58</td>
<td>110</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p<.05$)

Table 2-5 shows that there is a significant difference between responses given to subject control sentences questions and object control sentences questions (Fisher’s exact test, $n=168$, $p=0.0344$, $p<.05$). The ratio of YES responses in object control sentences questions (43%) is higher than the ratio of YES responses in subject control sentences questions (26%). This result supports NP2 preference: first graders prefer to use NP2 (Lili), which is the recent filler and adhered to the preposition dui, to fill the empty subject. Furthermore, the number of NO responses is significantly higher than that of YES responses to the question “Liangliang will do homework seriously today.” (YES 22 vs. NO 62). This result shows that first graders rejected the distant filler NP1 (Liangliang). This is an indirect and secondary indication that supports NP2 preference.

The higher ratio of YES responses to object control sentences questions and NO responses to subject control sentences questions showed that, NP2 (Lili), which is the recent filler with the preposition dui, is understood more easily as the empty subject by first graders. That is, first graders utilized the recency strategy or the preposition dui to “guess” the sentence meaning judging from the distribution of YES responses and NO responses. The strategies employed in first grade for the SOV word order are shown below.
(30) Strategies used in first grade for SOV order:

a. perceptual strategy: recency strategy

b. linguistic strategy: the preposition dui

Second grade

The results of second graders in the SOV word order are shown below.

Table 2-6: Questions and YES/NO responses in second grade for SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, distant filler)</td>
<td></td>
<td>32 (38%)</td>
<td>52 (62%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, recent filler, preposition dui)</td>
<td></td>
<td>42 (50%)</td>
<td>42 (50%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>74</td>
<td>94</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p= .1617$, n.s.)

There is no significant difference between YES/NO responses and sentence question type (Fisher’s exact test, $n=168$, $p= .1617$), as shown in Table 2-6. At first glance, it may seem that second graders employ no strategies to process the sentences. However, as second graders have better knowledge of matrix verbs and higher cognitive ability, it is appropriate to think that second graders did employ some strategies to “guess” the sentences (see the following section, the results of OSV word order support that second graders employ some strategies to “guess” the sentences). The insigificance may have been due to the result of mutual competition between NP1 preference and NP2 preference strategies.

For example, if second graders employ the recency strategy and primacy strategy
randomly, the nearest filler NP2 (Lili) should be preferred to fill the empty subject. At the same time, NP1 (Liangliang) at the beginning of the sentence would also be preferred to fill the empty subject. The competition between strategies led to an insignificant YES/NO responses between NP1 and NP2. As for other possibilities, the second graders might have used the recency strategy and the verb shuo randomly, since NP2 (Lili) is the nearest filler, while NP1 (Liangliang) is the agent of the verb shuo. Moreover, second graders may use the preposition dui and primacy strategy randomly, since the preposition dui is before NP2 (Lili), while NP1 (Liangliang) is at the beginning of the sentence. Also, the second graders might have used the preposition dui and the verb shuo randomly, since the preposition dui is before NP2 (Lili), while NP1 (Liangliang) is the agent of the verb shuo. The strategies employed in second grade for the SOV word order are shown below.

(31) Strategies used in second grade for SOV order:

   a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy
   b. perceptual strategy: recency strategy + linguistic strategy: the verb shuo
   c. linguistic strategy: the preposition dui + perceptual strategy: primacy strategy
   d. linguistic strategy: the preposition dui + linguistic strategy: the verb shuo

Third grade

The results of third graders in the SOV word order are shown below.
Table 2-7: Questions and YES/NO responses in third grade for SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, distant filler)</td>
<td>57 (68%)</td>
<td>27 (32%)</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>NP2 (Lili, object, recent filler, preposition dui)</td>
<td>41 (49%)</td>
<td>43 (51%)</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>98</td>
<td>70</td>
<td>168</td>
<td></td>
</tr>
</tbody>
</table>

(Fisher’s exact test: \(p<0.05\))

Results from third graders shows a significant difference between responses given to subject control sentence questions and object control sentence questions (Fisher’s exact test, \(n=168, p=0.0186, p<0.05\)), as shown in Table 2-7. In contrast to the results from first and second graders, third graders show a higher ratio of YES responses in subject control sentence questions (68%) than the ratio of YES responses in object control sentence questions (49%). Third graders seems to prefer NP1 (Liangliang) as the empty subject, as opposed to the results of first and second graders. Therefore, it is clarified that the “guess” process of third graders is different from that of first and second graders. Furthermore, the YES responses are significantly higher than the NO responses in the subject control sentence questions (YES 57 vs. NO 27). This result directly supports NP1 preference.

The cognitive ability of third graders is more developed than first and second graders, and half of the matrix verbs had been acquired. From the results, it seems that third graders might have preferred to use the filler at the beginning of the sentence (Liangliang), or the agent of the verb shuo (Liangliang) to fill the empty subject. These strategies led to a strong NP1 (Liangliang) preference. The strategies employed in third grade for the SOV word order are shown below.
(32) Strategies used in third grade for SOV order:

a. perceptual strategy: primacy strategy

b. linguistic strategy: the verb shuo

Fourth grade

The results of fourth graders in SOV word order are shown below.

Table 2-8: Questions and YES/NO responses in fourth grade for SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, distant filler)</td>
<td></td>
<td>56 (67%)</td>
<td>28 (33%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, recent filler, preposition dui)</td>
<td></td>
<td>48 (57%)</td>
<td>36 (43%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>104</td>
<td>64</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: \( p = .266 \), n.s.)

Despite having similar tendency to third graders, in which the ratio of YES responses in the subject control sentence questions (67%) is higher than the ratio of YES responses in the object control sentence questions (57%), the effect of the sentence question type to YES/NO responses is shown to be not significant (Fisher’s exact test, \( n = 168, p = .266 \)), as shown in Table 2-8. The same results are obtained for the OSV word order, too (see the following section). It may seem that fourth graders employ no strategies to “guess” and “process” the sentences. However, as fourth graders have better knowledge of matrix verbs and higher cognitive ability, it is appropriate to think that fourth graders did employ some strategies to “guess” and “process” the sentences. Given that fourth graders know more matrix verbs than third graders, multiple
strategies may have been employed, such as the 'primacy strategy', 'the verb shuo', and the use of control information of the matrix verbs (when they process the sentence including the acquired verbs). The strategies employed in fourth grade for the SOV word order are shown below.

(33) Strategies used in fourth grade for SOV order:

a. perceptual strategy: primacy strategy
b. linguistic strategy: the verb shuo
c. linguistic strategy: using the control information of the matrix verbs

Fifth grade

The results of fifth graders in SOV word order are shown below.

Table 2-9: Questions and YES/NO responses in fifth grade for SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, distant filler)</td>
<td></td>
<td>63 (67%)</td>
<td>21 (33%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, recent filler, preposition dui)</td>
<td></td>
<td>63 (57%)</td>
<td>21 (43%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>126</td>
<td>42</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p=0.999$, n.s.)

From Table 2-9, unlike the results of first, second, third and fourth graders, the number of YES responses for NP1 (Liangliang) among the fifth graders is the same to the number of YES responses for NP2 (Lili) (63:63). The number of NO responses for NP1 (Liangliang) is also the
same to the number of NO responses for NP2 (Lili) (21:21). These results show that the parsing of the fifth graders is different from children in the other grades.

The results of fifth graders show that the effect of sentence question type to YES/NO response is not significant (Fisher's exact test, n=168, \( p = .999 \)), as shown in Table 2-9. Different from other participants, two types of sentence questions show exactly the same distribution of YES and NO responses. In the fifth grade, YES responses are about equally preferred in both subject control sentence questions and object control sentence questions. Having known that fifth graders had already acquired the matrix verbs, which is an indispensable requirement for identifying the empty subject, the fifth grader could judge the empty subject by using information from the verb. The following discussion about the low percentage of NO responses and the RTs of each phrase also support that the fifth graders use the control information of the matrix verb in their judgment. In addition, I will discuss the findings from the percentage of NO responses and the RTs of phrase.

Table 2-10 shows the percentage of NO responses in the SOV word order.

Table 2-10: Percentage of NO responses in SOV order

<table>
<thead>
<tr>
<th></th>
<th>First Grade</th>
<th>Second Grade</th>
<th>Third Grade</th>
<th>Fourth Grade</th>
<th>Fifth Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distant filler,</td>
<td>62/84=73.8%</td>
<td>52/84=61.9%</td>
<td>27/84=32.1%</td>
<td>28/84=33.3%</td>
<td>21/84=25%</td>
</tr>
<tr>
<td>Subject control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sentence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recent filler,</td>
<td>48/84=57.1%</td>
<td>42/84=50%</td>
<td>43/84=51.2%</td>
<td>36/84=43%</td>
<td>21/84=25%</td>
</tr>
<tr>
<td>Object control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sentence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t test</td>
<td>( t(11) = 1.48, p = .17 ) n.s.</td>
<td>( t(11) = 1.53, p = .15 ) n.s.</td>
<td>( t(11) = 1.84, 0.05 &lt; p &lt; .10 ) n.s.</td>
<td>( t(11) = 1.22, p = .25 ) n.s.</td>
<td>( t(11) = .27, p = .79 ) n.s.</td>
</tr>
</tbody>
</table>

Table 2-10 shows the percentage of NO responses for NP1 (Liangliang, subject, distant
filler) in subject control sentences and NP2 (Lili, object, recent filler, the preposition dui) in object control sentences among children from each grade. There are many NO responses among first and second grades to the question “Liangliang (subject, distant filler) will do homework seriously” in subject control sentences (62 and 52 respectively), and nearly half are NO responses to the question “Lili (object, recent filler, the preposition dui) will do homework seriously” in object control sentences (48 and 42 respectively). The children of first and second grades had not acquired the matrix verbs, thus they could not judge the sentence type. The percentage of children from the lower grades selected Lili (object, recent filler, the preposition dui) as the empty subject was 73.8%, 42.9% (100% - 57.1%) in the first grade, and 61.9%, 50% (100%-50%) in the second grade. These high ratios suggest that these children might have employed the recency strategy or the preposition dui in answering the experimental task. The percentage of NO responses decreased in the fifth grade (25% and 25% respectively for the subject control sentence and the object control sentence). These results indicate that the children from the fifth grade had had the ability to judge the question, since they had acquired the matrix verbs. Verb control information becomes available only at a later stage of language development. In other words, the parser uses a recency strategy or the preposition dui at an earlier stage of language development, and shifts to a “Linguistic strategy” after language acquisition is complete.

Next, I will see whether the processing is the same with adults from the RTs of each phrase in the fifth grade. Since the participants of the off-line experiment are different from those of the on-line experiments, acquired and unacquired verbs for each grade from second grade to fourth grade were unknown. Therefore, I will not touch on the RTs of the sentences including the acquired matrix verbs from the second grade to the fourth grade.
Figure 2-1 shows the RTs of each phrase in fifth grade for the SOV word order. The RTs of P3 for subject control sentences are shorter than those of the object control sentences (subject control verb: $M=1824\text{ms}$, object control verb: $M=2038\text{ms}$). The difference had significant tendency in the participant analysis ($t(11) = 2.132, p=.056$), but is not significant in item analysis ($t(27) = 1.364, p=.184$). The RTs of P6 (subject control sentence: $M=1437\text{ms}$, object control verb: $M=1361\text{ms}$) is not significant between subject control sentences and object control sentences in both the participant analysis ($t(11) = .953, p=.361$) and item analysis ($t(27) = .642, p=.526$).

There are two verbs in the above experimental sentences. One is the matrix verb P3, the other is the complement clause verb P6. If the empty subject had been identified at the stage before P6 is input, then the difference in the RTs of P6 should not be observed, since the parser read only the verb. If the empty subject had not been identified at the time before P6 is input, then the empty subject would be identified when the P6 is input, thus a difference in the RTs of P6 should be observed, while the difference in the RTs of P3 would not be observed.
Since no significant difference in the RTs of P6 is found for the SOV word order, it is assumed that the empty subject had already been filled before the complement sentence verb P6 appeared. From the difference of the RTs of P3, I assume that the parser is undergoing some kind of processing at the time when P3 is input. This explanation follows from the premise that the control information of the verb P3 is immediately exploited, as is shown in the adults’ case (see section 1.2.3).

From the above results, the strategy employed in fifth grade for the SOV word order is shown below.

(34) Strategy used in fifth grade for SOV order:

linguistic strategy: immediate use of the control information of the verb

In conclusion, first graders at an earlier stage of language development used “Perceptual strategy” (i.e., recency strategy) or “Linguistic strategy” (i.e., the preposition dui), and would shift to a complete “Linguistic strategy” in the fifth grade after language acquisition has been completed.

If first graders employ a recency strategy or the preposition dui to fill the empty subject, it is predicted that the same results can be obtained when the word order of the subject and the object is swapped. On the other hand, if children in the fifth grade use the verb control information to fill the empty subject, the same result should also be obtained when the word order of the subject and the object is swapped. Now, I will introduce the results for the OSV word order.
2.2.2.4 OSV word order

In the OSV word order, NP1 (Liangliang) and NP2 (Lili) are swapped. Different from the SOV word order, NP1 (Liangliang) becomes the nearest filler to PRO. Will the difference in word order lead to different results?

2.2.2.4.1 Prediction

Unacquired verbs

As discussed above, first graders had not acquired the experimental verbs. Therefore, control information of the verb could not be used. If no strategy is employed at all, the number of YES and NO responses to the question “Liangliang will do homework seriously today.” would be about the same. The number of YES and NO responses to the question “Lili will do homework seriously today.” would also be about the same. Also, the insignificant difference between the YES/NO responses may be attributed to the competing strategies.

If they do employ some strategies to “guess” the sentence, the “guess” would not have been done with the use of verb information. The only means is to use information from the nouns.

i): Perceptual strategy – recency strategy

If children in the first grade make use of the recency strategy, as the subject Liangliang is the nearest filler to the PRO, more YES responses to the question “Liangliang will do homework seriously today.” than the number of YES responses to the question “Lili will do homework seriously today.” would be expected. Moreover, more NO responses to the question “Lili will do homework seriously today.” than the question “Liangliang will do homework seriously today.” would also be expected, since NP2 (Lili) is the distant filler to PRO in the
ii): Perceptual strategy – primacy strategy

If the first graders utilize the primacy strategy, by which the filler at the beginning of sentence is preferred to fill the empty subject, there would be more YES responses to the question “Lili will do homework seriously today.” than the question “Liangliang will do homework seriously today.”, because NP2 (Lili) is at the beginning of the sentence. Moreover, we would expect there to be more NO responses to the question “Liangliang will do homework seriously today.” than the question “Lili will do homework seriously today.”, since NP1 (Liangliang) is not at the beginning of the sentence in the OSV word order.

iii): Linguistic strategy – the verb shuo

If they utilize the verb shuo to process the empty subject, there would be more YES responses to the question “Liangliang will do homework seriously today.” than the question “Lili will do homework seriously today.”, because NP1 (Liangliang) is the subject of the sentence. Moreover, we would also expect there to be more NO responses to the question “Lili will do homework seriously today.” than the question “Liangliang will do homework seriously today.”, since NP2 (Lili) is the object of the sentence.

iv): Linguistic strategy – the preposition dui

If they use the preposition dui to “guess” the sentence, there would be more YES responses to the question “Lili will do homework seriously today.” than the question “Liangliang will do homework seriously today.”, because the preposition dui appears before NP2 (Lili). Moreover, there would also be more NO responses to the question “Liangliang will
do homework seriously today.” than the question “Lili will do homework seriously today.”, since the preposition dui does not appear before NP1 (Liangliang).

Summary

The recency strategy and primary strategy are “Perceptual strategies”, while the verb shuo, the preposition dui are “Linguistic strategies”. The predictions of unacquired verbs in the OSV word order are shown below.

Table 2-11: Predictions of answers for the unacquired verbs in OSV order at first grade

<table>
<thead>
<tr>
<th>no strategy employed</th>
<th>YES responses = NO responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>some strategies employed</td>
<td>recency strategy</td>
</tr>
<tr>
<td></td>
<td>primacy strategy</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>linguistic strategies</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Acquired verbs

It is expected that upper grade students would yield similar results as the SOV word order. The children in the fifth grade should have already acquired control information of the experimental verbs (fashi, zhufü), which is confirmed by the results of the off-line experiment.
In this case, the fifth graders are expected to use the control information of the verbs, and be able to judge the questions correctly.

If the fifth grader participants fill the empty subject by referring to the control information of the matrix verbs, there should not be any significant difference between the RTs of P6 (zuozuoye 'do homework'), since the agent of the complement clause should have already been identified at the time when P6 is shown on the screen. On the other hand, when the matrix verb P3 (fashi, zhufu) is input, the RTs of the subject control verb (fashi) should be shorter than that of the object control verb (zhufu), if the fifth graders process sentences as sophisticatedly as adults. The predictions of acquired verbs in the OSV word order are shown below.

Table 2-12: Predictions of RTs and correct answer for the acquired verbs in OSV order at fifth grade

<table>
<thead>
<tr>
<th></th>
<th>(29c) &lt; (29d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTs of P3</td>
<td></td>
</tr>
<tr>
<td>RTs of P6</td>
<td>(29c) = (29d)</td>
</tr>
<tr>
<td>Percentage of correct answers</td>
<td>high</td>
</tr>
</tbody>
</table>

2.2.2.4.2 Results and discussion

I will now turn to the results of OSV sentences. It is interesting to see if factors such as the reversed order of the subject and object would cause any changes to the strategies for parsing.

First grade

The results of first graders in the OSV word order are shown below.
Table 2-13: Questions and YES/NO responses in first grade for OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, recent filler)</td>
<td></td>
<td>52 (62%)</td>
<td>32 (38%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, distant filler, preposition dui)</td>
<td></td>
<td>20 (24%)</td>
<td>64 (76%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>72</td>
<td>96</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p < .001$)

From Table 2-13, the sentence question type (Liangliang vs. Lili) is found to have a significant effect on the participants’ response (Fisher’s exact test, $n=168$, $p=.0000$, $p<.001$). The ratio of YES responses in subject control sentence questions (62%) is higher than the ratio of YES responses in object control sentence questions (24%). This is a direct indication that supports NP1 preference. Moreover, the number of YES responses is significantly higher than the NO responses to the question “Liangliang will do homework seriously today.” (YES 52 vs. NO 32). This result also strongly supports NP1 preference.

Furthermore, the number of NO responses to the question “Lili will do homework seriously today.” is significantly higher than that of YES responses (YES 20 vs. NO 64). This result clearly shows that first graders reject the NP2 (Lili, object, distant filler, preposition dui). This indirectly supports NP1 preference.

These results show that first graders preferred NP1 (Liangliang, subject, recent filler) to fill the empty subject. These results are compatible with the predictions when the recency strategy or the verb shuo is used. These strategies led to a strong NP1 preference. The strategies employed in first grade for the OSV word order are shown below.
(35) Strategies used in first grade for OSV order:

a. perceptual strategy: recency strategy

b. linguistic strategy: the verb shuo

Second grade

The results of second graders for the OSV word order are shown below.

Table 2-14: Questions and YES/NO responses in second grade for OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, recent filler)</td>
<td>47 (56%)</td>
<td>37 (44%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, distant filler, preposition dui)</td>
<td>32 (38%)</td>
<td>52 (62%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td>79</td>
<td>89</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p < .05$)

Table 2-14 shows that there is a significant effect of sentence question type on the YES/NO responses (Fisher’s exact test, $n=168$, $p = .0301$, $p < .05$). The ratio of YES responses in subject control sentence questions (56%) is higher than the ratio of YES responses in object control sentence questions (38%). It can be said that the recent filler NP1 is favored to fill the empty subject. This is a direct indication of NP1 preference.

In addition, the number of NO responses to the question “Lili will do homework seriously today.” is significantly higher than that of YES responses (YES 32 vs. NO 52). This also shows that second graders reject using NP2 (Lili, object, distant filler, preposition dui) to fill the empty subject.
From the above results, second graders seemed to prefer NP1 (Liangliang) to fill the empty subject in the OSV word order. That is, second graders might have utilized the recency strategy, or the verb *shuo* to "guess" the sentence. The strategies employed in second grade for the OSV word order are shown below.

(36) Strategies used in second grade for OSV order:

a. perceptual strategy: recency strategy  
b. linguistic strategy: the verb *shuo*

Third grade

The results of third graders for the OSV word order are shown below.

Table 2-15: Questions and YES/NO responses in third grade for OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, recent filler)</td>
<td></td>
<td>43 (51%)</td>
<td>41 (49%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, distant filler, preposition <em>dui</em>)</td>
<td></td>
<td>46 (55%)</td>
<td>38 (45%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>89</td>
<td>79</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p = .7573$, n.s.)

From Table 2-15, the YES/NO responses are distributed evenly among NP1 (Liangliang) and NP2 (Lili) in the third grade, in contrast to the lower grades (the first, second grades). Either NP1 (Liangliang) or NP2 (Lili) is prominent as a filler of the empty subject in the third grade children. Subject and object control sentence questions have similar distribution of YES/NO.
responses (Fisher’s exact test, n=168, \(p=0.7573\)). Both NPs are equally prominent as a filler of the empty subject.

From the results of the SOV word order, the third graders employed some strategies to “guess” and “process” the sentences. In the OSV word order, they might have used both the recency strategy (Liangliang) (or the verb shuo) and the primacy strategy (Lili) (or the preposition dui) to process the empty subject sentences. The recency strategy or the verb shuo would make NP1 (Liangliang) prominent, and the primacy strategy or the preposition dui would make NP2 (Lili) prominent. Due to the competition between the two NPs, the effect of the sentence type was not significant. The strategies employed in third grade for the OSV word order are shown below.

(37) Strategies used in third grade for OSV order:

a. perceptual strategy: primacy strategy + perceptual strategy: recency strategy
b. perceptual strategy: primacy strategy + linguistic strategy: the verb shuo
c. linguistic strategy: the preposition dui + perceptual strategy: recency strategy
d. linguistic strategy: the preposition dui + linguistic strategy: the verb shuo

Fourth grade

The results of fourth graders for the OSV word order are shown below.
Table 2-16: Questions and YES/NO responses in fourth grade for OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, recent filler)</td>
<td></td>
<td>36 (43%)</td>
<td>48 (57%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, distant filler, preposition dui)</td>
<td></td>
<td>40 (48%)</td>
<td>44 (52%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>76</td>
<td>92</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p = .6420$, n.s.)

From Table 2-16, the same tendency with third graders is found in the fourth grade: the YES/NO responses are about the same in NP1 (Liangliang) and NP2 (Lili), and the YES/NO responses are about the same in both sentences question types. The fourth graders know more matrix verbs than the third graders. It seems that multiple strategies, such as the strategies used by third graders (see (37)) and the use of control information of the matrix verbs (when they process the sentence including the acquired verbs) had been employed by the fourth graders. The strategies employed in fourth grade for the OSV word order are shown below.

(38) Strategies used in fourth grade for OSV order:

a. perceptual strategy: primacy strategy + perceptual strategy: recency strategy
b. perceptual strategy: primacy strategy + linguistic strategy: the verb shuo
c. linguistic strategy: the preposition dui + perceptual strategy: recency strategy
d. linguistic strategy: the preposition dui + linguistic strategy: the verb shuo
e. linguistic strategy: using the control information of the matrix verbs
Fifth grade

The results of fifth graders in OSV word order are shown below.

Table 2-17: Questions and YES/NO responses in fifth grade for OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Liangliang, subject, recent filler)</td>
<td></td>
<td>61 (73%)</td>
<td>23 (27%)</td>
<td>84</td>
</tr>
<tr>
<td>NP2 (Lili, object, distant filler, preposition dui)</td>
<td></td>
<td>65 (77%)</td>
<td>19 (23%)</td>
<td>84</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>126</td>
<td>42</td>
<td>168</td>
</tr>
</tbody>
</table>

(Fisher's exact test: $p = .5933$, n.s.)

Among the fifth graders, the distribution of YES and NO responses for both sentence question types are about the same. This is similar to results of third and fourth graders. However, there are more YES responses (and less NO responses) than third and fourth graders. These results suggest that the parsing of the fifth graders is different from that of third and fourth graders. The high YES responses show that the fifth graders could answer the questions correctly. Since fifth grade children had already acquired the matrix verbs needed to identify the empty subject, they could judge the empty subject by using information from the verb. The following discussion about the percentage of NO responses and the RTs of each phrase also support the view that the fifth graders use the control information of the matrix verb.

Next, I will see whether the percentage of NO responses decreases as the verb acquisition level rises.
Table 2-18 shows the percentage of NO responses among children from the first to fifth grades for the OSV word order. Among first and second graders, there is a large number of NO responses for “Lili will do homework seriously today” in object control sentences (64 and 52 respectively) and YES responses for “Liangliang will do homework seriously today.” in subject control sentences (52 (84-32) and 47 (84-37) respectively). These results suggest that lower grades tend to fill the empty subject with the nearest filler, the agent of verb shuo (Liangliang), but not the farther filler (Lili). The results from fifth graders show a drastic decrease in the percentage of NO responses (27.4%, 22.6% respectively for the subject control sentence and the object control sentence). That is, fifth graders could judge the YES/NO question correctly, since they had acquired the correct meaning of matrix verbs. These results support the view that verb control information becomes available only at the later stage of language development.

Next, from the RTs of each phrase, I will see whether the fifth graders utilize the same strategy as adults to process empty subject sentences.

<table>
<thead>
<tr>
<th></th>
<th>First Grade</th>
<th>Second Grade</th>
<th>Third Grade</th>
<th>Fourth Grade</th>
<th>Fifth Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject control sentence</td>
<td>32/84= 38.1%</td>
<td>37/84= 44%</td>
<td>41/84= 48.8%</td>
<td>48/84= 57.1%</td>
<td>23/84= 27.4%</td>
</tr>
<tr>
<td>Object control sentence</td>
<td>64/84= 76.2%</td>
<td>52/84= 61.9%</td>
<td>38/84= 45.2%</td>
<td>44/84= 52.4%</td>
<td>19/84= 22.6%</td>
</tr>
<tr>
<td>(t_{(11)}) (= 3.09, p&lt;.05)</td>
<td>(t_{(11)} = 1.59, p = .14) n.s.</td>
<td>(t_{(11)} = .593, p = .57) n.s.</td>
<td>(t_{(11)} = .219, p = .83) n.s.</td>
<td>(t_{(11)} = .543, p = .60) n.s.</td>
<td></td>
</tr>
</tbody>
</table>
Figure 2-2 shows the RTs of each phrase among fifth graders for the OSV word order. The RTs of P3 for subject control sentences are shorter than those of the object control sentences (subject control verb: $M=1539\text{ms}$, object control verb: $M=1785\text{ms}$), and the difference is significant in both participant analysis ($t(11) = 3.037, p = .011$), and item analysis ($t(27) = 2.035, p = .052$). The RTs of P6 (subject control sentence: $M=1258\text{ms}$, object control verb: $M=1310\text{ms}$) is not significant between subject control sentences and object control sentences in both the participants analysis ($t(11) = .377, p = .714$) and item analysis ($t(27) = .518, p = .608$).

Since no significant difference in the RTs of P6 is observed in the OSV word order, it is considered that the empty subject had already been filled before the complement sentence verb P6 appeared. From the difference of the RTs of P3, I assume that the parser is undergoing some kind of processing at the time when P3 is input. This explanation follows from the premise that control information of the verb P3 is immediately exploited.

From above results, the strategy employed in fifth grade for the OSV word order is shown.
In conclusion, in the lower graders, the empty subject is preferred to be filled by the nearest filler, or the agent of the verb shuo. Children in the fifth grade utilized the control information of the matrix verbs.

2.2.3 General discussion from SOV and OSV orders

First grade

First graders knew all the words in the experimental sentences excluding the matrix verbs according to the results of the off-line experiment. The ratio of YES responses for NP2 (Lili, recent filler) (43%) are higher than NP1 (Liangliang, distant filler) (26%) in the SOV word order. Moreover, the ratio of YES responses for NP1 (Liangliang, recent filler) (62%) are higher than NP2 (Lili, distant filler) (24%) in the OSV word order. In addition, the number of NO responses for NP1 (Liangliang) (62), i.e., NP1-rejection, are higher than the number of YES responses for NP1 (22) in the SOV word order. Also, the number of YES responses for NP1 (Liangliang, recent filler) (52) are higher than the number of NO responses for NP1 (32), and the number of NO responses for NP2 (Lili, distant filler) (64), i.e., NP2-rejection, are higher than the number of YES responses for NP2 (20) in the OSV word order.

In the SOV word order, I assumed that the first graders are using the recency strategy or the preposition dui to “guess” the sentence (see (30)). However, in the OSV word order, the results did not support the use of the preposition dui (see (35)). These results show that when
first graders processed the empty subject sentences, the nearest filler is preferred in both the SOV and OSV word orders. The strategy used by first graders in the SOV and OSV word orders is shown below.

Table 2-19: Summary of first graders’ strategy for SOV and OSV orders

<table>
<thead>
<tr>
<th>First grade</th>
<th>perceptual strategy: recency strategy</th>
</tr>
</thead>
</table>

Second grade

The second graders knew a small amount of the matrix verbs. There is a higher ratio of YES responses for NP2 (Lili, recent filler) (50%) than the ratio of YES responses for NP1 (Liangliang) (38%), however, the difference between YES/NO responses and sentence question type is not significant. In the OSV word order, there is a significantly higher ratio of YES responses for NP1 (Liangliang) (56%) than the ratio of YES responses for NP2 (Lili) (38%).

Consider the results of the SOV word order (see (31)). The results of the OSV word order (see (36)) did not support that second graders used the primacy strategy and preposition dui. Then, the possibility that second graders utilized the recency strategy and the verb shuo randomly is high. The strategies used by second graders in the SOV and OSV word orders are shown below.

Table 2-20: Summary of second graders’ strategies for SOV and OSV orders

<table>
<thead>
<tr>
<th>Second grade</th>
<th>perceptual strategy: recency strategy + linguistic strategy: the verb shuo</th>
</tr>
</thead>
</table>
Third grade

The third graders knew half of the matrix verbs. In the SOV word order, the ratio of YES responses for NP1 (Liangliang) (68%) are higher than the ratio of YES responses for NP2 (Lili) (49%). In the OSV word order, the ratio of YES/NO responses for NP1 (liangliang) and NP2 (Lili) are almost even. The NP1 preference observed in the SOV word order is not observed in the OSV word order. What caused this change when the word order was reversed? The third graders used the ‘the verb shuo’ and ‘primacy strategy’ randomly, which might explain these results. In the SOV word order, NP1 (Liangliang) is the agent of the verb shuo and is also at the beginning of the sentence. This might cause the NP1 preference. However, in the OSV word order, NP2 (Lili) appeared at the beginning of the sentence, and this weakened ‘the verb shuo’, so NP1 (Liangliang) preference is not observed. As for the third graders, we point out the possibility that with the increase in memory capacity, the effect of primacy may have become more pronounced.

The results of the SOV word order (see (32)) did not support the results of the OSV word order (see (37)), which indicated that third graders employed the preposition dui and recency strategy. The third graders may have used the primacy strategy and the verb shuo randomly. The strategies used by third graders in the SOV and OSV word orders are shown below.

Table 2-21: Summary of third graders’ strategies for SOV and OSV orders

| Third grade | perceptual strategy: primacy strategy + linguistic strategy: the verb shuo |

Fourth grade

The fourth graders knew more matrix verbs than the third graders. The ratio of YES/NO
responses for NP1 (Liangliang) and NP2 (Lili) are almost even in both the SOV word order and OSV word order. It seems that multiple strategies, such as the ‘primacy strategy’ and ‘the verb shuo’, which are used by third graders, as well as the control information of the matrix verbs are used when they processed the sentence including the acquired matrix verbs. These multiple factors made the answer more complicated. The strategies used by fourth graders in the SOV and OSV word orders are shown below.

Table 2-22: Summary of fourth graders’ strategies for SOV and OSV orders

<table>
<thead>
<tr>
<th>Fourth grade</th>
<th>i) perceptual strategy: primacy strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii) linguistic strategy: the verb shuo</td>
</tr>
<tr>
<td></td>
<td>iii) linguistic strategy: using the control information of the matrix verbs</td>
</tr>
</tbody>
</table>

Fifth grade

The fifth graders had acquired the matrix verbs, and they had the ability to judge the question correctly. The results from fifth graders showed a drastic decrease in the percentage of NO responses, i.e., 25% and 25% respectively for the subject control and object control sentences in the SOV word order, and 27.4% and 22.6% respectively in the OSV word order for the subject control sentence and object control sentences. These results indicate that verb control information becomes available at a later stage of language development.

Moreover, in the fifth grade, no significant difference in the RTs of P6 is observed in both the SOV and OSV word orders. It is considered that the empty subject had already been filled before the complement sentence verb P6 appeared. From the difference of the RTs of P3 in both the SOV and OSV word orders, it is possible that the parser is undergoing some kind of processing at the time when P3 is input. This explanation follows from the premise that control
information of the verb P3 is immediately exploited. The strategy used by fifth graders for the
SOV and OSV word orders is shown below.

Table 2-23: Summary of fifth graders’ strategy for SOV and OSV orders

| Fifth grade | linguistic strategy: immediate use of the control information of the verb |

The results of the processing of Chinese empty subject sentences by elementary school
children suggest that the recency strategy is used by lower graders who have not acquired the
matrix verbs, while the control information of the matrix verbs are used by upper graders who
have acquired the matrix verbs.

2.3 Concluding remarks

From the results of the SOV word order and OSV word order, it is clear that first graders
in the elementary school who have not acquired the meaning of matrix verbs and have relatively
lower cognitive ability, prefer to use the ‘recency strategy’ to fill the empty subject. That is,
non-linguistic and general-purpose strategies are utilized at an earlier stage of language
development.

For second graders, whose cognitive ability are slightly more advanced than the first
graders, besides the recency strategy, “Linguistic strategies” (i.e., ‘the verb shuo’) is also
available.

Third graders, whose linguistic ability and cognitive ability are more advanced than the
lower graders, were found to use the primacy strategy, but not the recency strategy, to process
the sentences. Both non-linguistic strategy (i.e., ‘primacy strategy’) and linguistic strategy (i.e.,
‘the verb shuo’) are utilized in a mixed way. As for the third graders, we point out the
possibility that with the increase in memory capacity, the effect of primacy may have become more pronounced.

The fourth graders acquired more matrix verbs than the third graders, and parsing has also become more complex. It seemed that both linguistic strategy (i.e., ‘the verb shuo’, and the use of control information on verb) and non-linguistic strategy (i.e., ‘primacy strategy’) have been used by the fourth graders, and these factors made the answer more complicated.

The fifth graders, who have acquired all the matrix verbs in the experimental sentences, used the control information to process the sentences. Thus, it shows that verb control information (‘Linguistic strategy’) becomes available at a later stage of language development.

The strategies used at different verb acquisition levels are shown below.

Graph 2-1: The results of L1 Chinese

- The first grade: Perceptual strategy: recency strategy
- The second grade: Perceptual strategy: recency strategy, Linguistic strategy: the verb shuo
- The third grade: Perceptual strategy: primacy strategy, Linguistic strategy: the verb shuo
- The fourth grade: Perceptual strategy: primacy strategy, Linguistic strategies: the verb shuo, using control information on verb
- The fifth grade: Linguistic strategy: immediate use of the control information of the verb
I claim that parsing strategies shift from “Perceptual strategy” to “Linguistic strategy” along the development of linguistic knowledge. I refer to this proposal as the “Developmental Shift of Parsing Strategies (DSPS)” hypothesis, as stated in (40).

(40) Developmental Shift of Parsing Strategies hypothesis:

The parsing strategies shift from “Perceptual strategy” to “Linguistic strategy” along the development of linguistic knowledge.

If DSPS hypothesis is correct, it will apply to all languages. Japanese is different from Chinese in that case-marking particles are attached to the former. The case-marking particles are used even by speakers at an early stage of language development. In L1 Japanese, is the sentence “guessing” and “parsing” process the same as L1 Chinese, in which the strategy shifts from “Perceptual strategy” to “Linguistic strategy”? In order to verify the applicability of the DSPS hypothesis and the properties of the “guessing” and “parsing” process, I conducted another experiment in Chapter 3.
Chapter 3: Processing empty subject sentences among Japanese children

In Chapter 2, through the experiments on Chinese elementary school children, I proposed the “Developmental Shift of Parsing Strategies (DSPS)” hypothesis, which states that a non-linguistic, general-purpose strategy is utilized at an early stage of language development, and shifts to a language-specific strategy at a later stage of language development.

If the DSPS hypothesis is a universal hypothesis, it should be applicable to other languages. Chinese noun phrases have no case-marking system that signifies their grammatical relations with the verb. Due to the lack of case information, one could argue that the parser is allowed to use “Perceptual strategies” solely based on distance information at the stage when the matrix verb has not been acquired. Since the matrix verb is indispensable in identifying the empty subject, if the verb is not known to (not acquired by) the participants, there is a possibility that the perceptual information may become the most important information.

In contrast, Japanese is a language which uses case-marking particles. Case particles are added to the end of noun phrases. Even at a stage where the lexical properties of the matrix verb have not yet been acquired, it is possible that the parser uses the information provided by the case-marking particles. As discussed in Chapter 1, “Perceptual strategy” which separates parsing (sentence processing) from the representation of the grammar and linguistic knowledge, explains the process of parsing by using more general cognitive concepts, e.g., position or number. However, the “Transparency hypothesis” suggests that the parser and the properties of the grammar can refer to each other. If a Japanese child uses information of case-marking particles, one can suggest that the parser and the grammar can refer to each other. In this case, observing the DSPS hypothesis becomes impossible. Since the use of case-marking particles is not considered a non-linguistic strategy, the shift from a non-linguistic strategy to a linguistic
strategy cannot be verified.

On the other hand, consider the case in which children disregard information of case particles, and use distance as high priority information. It is possible that the “Perceptual strategy” is too strong for the parser to see the grammar. That is, the parser will need more effort to process the sentence at a lower level of cognitive ability. This causes the bypassing of available grammatical information and the high priority of cognitive strategy. In this case, the DSPS hypothesis can be observed.

The intervention of case particles makes the processing of Japanese empty subject sentences more complicated. Whether the parser uses the case particle may yield different results from Chinese. It is therefore interesting to see whether the DSPS hypothesis applies to the processing of Japanese empty subject sentences among elementary school children.

In this chapter, I will present an experiment on Japanese school children, which aims at testing the parsing mechanism of Japanese empty subject sentences among participants at different stages of language development. Section 3.1 presents the results of empty subject sentences with both canonical and reversed word order. Section 3.2 concludes the chapter by bringing out the implications of the reported difference across age-groups, and suggests that the DSPS hypothesis applies to Japanese.

3.1 Experiment

3.1.1 Experimental Design

The experimental sentences are shown below. Japanese script with Kana and Kanji were used in the actual experiment. The matrix verb *ibatta* ‘boasted’ in (41a, c) is a subject control verb, while the matrix verb *susumeta* ‘persuaded’ in (41b, d) is an object control verb. The verbs used for the experimental sentences (five subject control verbs and five object control verbs)
were chosen from a textbook used in the elementary school of Fukuoka, Japan, where the
participants were recruited. (41a, b) take the ‘subject – object’ word order, and (41c, d) take the
‘object – subject’ word order. Thus, the experiment design is 2 (verb types) × 2 (word orders).

(41) a. **SOV order, Subject control sentence**

| P1     | P2      | P3                      | P4     | P5
|--------|---------|-------------------------|--------|-----
| けんじくん ga | きのう/  | まりさん ni/ [PRO1 | パソコンを ka | ] ことを/iibatta. |

Kenji-NOM yesterday Mari-DAT computer-ACC buy fact-ACC boasted

‘Yesterday, Kenji boasted to Mari that he would buy a personal computer.’

[Question sentence] けんじくんが パソコンを かいます。

Kenji-kun-ga pasokon-o kaimasu

‘Kenji will buy a personal computer.’

b. **SOV order, Object control sentence**

けんじくん ga/きのう/まりさん ni/ [PRO2 | パソコンを ka | ] ことを/iibmeta.


Kenji-NOM yesterday Mari-DAT computer-ACC buy fact-ACC persuaded

‘Yesterday, Kenji persuaded Mari to buy a personal computer.’

[Question sentence] まりさんが パソコンを かいます。

Mari-san-ga pasokon-o kaimasu

‘Mari will buy a personal computer.’
c. **OSV order, Subject control sentence**

まりさん2にきのうけんじくん1が[PRO1パソコンをかう]ことをいばった。


‘Yesterday, Kenji boasted to Mari that he would buy a personal computer.’

[Question sentence] けんじくんがパソコンをかいます。

Kenji-kun-ga pasokon-o kaimasu

‘Kenji will buy a personal computer.’

d. **OSV order, Object control sentence**

まりさん1にきのうけんじくん1が[PRO2パソコンをかう]ことをすすめた。

Mari-san1-ni kinoo Kenji-kun1-ga [PRO2 pasokon-o kau] koto-o susumeta.

Mari-DAT yesterday Kenji-NOM computer-ACC buy fact-ACC persuaded

‘Yesterday, Kenji persuaded Mari to buy a personal computer.’

[Question sentence] まりさんがパソコンをかいます。

Mari-san-ga pasokon-o kaimasu

‘Mari will buy a personal computer.’

Twenty pairs of experimental sentences like (41), which consisted of four conditions (SOV word order vs. OSV word order; subject control vs. object control), were used, making a total of eighty sentences. Latin square method was adopted in this experiment. The eighty experimental sentences were divided into four lists. This was to ensure that only one condition from each pair was presented to each participant. Each list was composed of fifty-two sentences.
including twenty experimental sentences, twenty filler sentences, six practice sentences and six warm-up sentences (see Appendix D). Experimental and filler sentences were presented with a random order in the list.

3.1.2 Apparatus and Procedure

Eighty participants from the first to fifth grade (sixteen participants in each grade) participated in this experiment. All participants were native Japanese speakers studying in elementary school. All participants had normal or corrected eyesight. The average age of first graders is seven years and six months (range: 7.1-7.10), and the standard deviation is 2.3. There are 7 boys and 9 girls. The average age of second graders is eight years and four months (range: 7.11-8.8), and the standard deviation is 2.6. There are 6 boys, and 10 girls. The average age of third graders is nine years and five months (range: 9.1-9.8), and the standard deviation is 2.0. There are 5 boys, and 11 girls. The average age of fourth graders is ten years and two months (range: 9.11-10.6), and the standard deviation is 2.4. There are 8 boys, and 8 girls. The average age of fifth graders is eleven years and four months (range: 10.11-11.8), and the standard deviation is 2.7. There are 10 boys and 6 girls.

Table 3-1: The participants in experiment

<table>
<thead>
<tr>
<th>Grade</th>
<th>Male : Female</th>
<th>Average Age (Range)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>7:9</td>
<td>7.6 (7.1-7.10)</td>
<td>2.3</td>
</tr>
<tr>
<td>Second</td>
<td>6:10</td>
<td>8.4 (7.11-8.8)</td>
<td>2.6</td>
</tr>
<tr>
<td>Third</td>
<td>5:11</td>
<td>9.5 (9.1-9.8)</td>
<td>2.0</td>
</tr>
<tr>
<td>Fourth</td>
<td>8:8</td>
<td>10.2 (9.11-10.6)</td>
<td>2.4</td>
</tr>
<tr>
<td>Fifth</td>
<td>10:6</td>
<td>11.4 (10.11-11.8)</td>
<td>2.7</td>
</tr>
</tbody>
</table>
The experiment was conducted with LinguaLab running on a CX835LS Dynabook notebook computer. Each trial consisted of two parts, namely the self-paced reading task and the comprehension task. In the self-paced reading task, participants were asked to read sentences in a moving window. The sentence was chunked into phrases. One phrase was displayed at a time. Participants were instructed to press the “Space” key on a standard keyboard at the beginning of each trial. A ‘★’ sign appeared to signal the beginning of a sentence. Participants were told to press the same space key immediately after they had finished reading the text on the screen. Once the key was pressed, the moving window would move rightward, so that the previous chunk would disappear from the screen and the next chunk would show up. All sentences ended with a full stop mark (。). The comprehension task was to start once the full stop mark had been read. A YES/NO question about the subject control sentence, like “Kenji will buy a personal computer”, and a question about the object control sentence, like “Mari will buy a personal computer” were displayed in the middle of the screen. A subject control sentence was always followed by a “correct” sentence in which the subject of the control sentence was also the subject of the question sentence. In the same way, an object control sentence was always followed by a “correct” sentence in which the object of the control sentence was the object of the question sentence. Participants were instructed to respond to the questions using either the YES or NO key.

The number of YES responses and NO responses was calculated for each question sentence. As discussed in Chapter 2, the response pattern of YES (judgment as correct in a correct sentence) and NO (judgment as wrong in a wrong sentence) is different. In the YES responses, only one correct positive evidence supports the YES answer, whereas it is necessary to check all the negative possibilities in the NO responses. Thus, NO responses will require more time and will be less accurate than the YES responses. Therefore, we assume that the YES
responses support clearly what the participants selected, e.g., having answered the question “Kenji will buy a personal computer.” as YES clearly supports Kenji-kun (henceforth “NP1”) preference. On the other hand, NO response means a kind of “rejection”. For example, a NO response to the question “Mari will buy a personal computer.” indicates that the participants have rejected Mari-san (henceforth “NP2”) as a possible answer to the preceding empty subject sentence. This NP2-rejection leads to the two possible interpretations: NP1 (Kenji-kun) or a third party (other than NP1 and NP2). Since the rejection of NP2 includes NP1 interpretation, it might support NP1 preference indirectly and secondarily. That is, the YES responses to NP1/NP2 support NP1/NP2 preference directly, whereas NO responses to NP1/NP2 support NP2/NP1 preference indirectly and secondarily.

Following the on-line tasks, the participants were asked whether they knew the subject/object control verbs used in the experiments. This off-line experiment was carried out after the on-line experiment. This was unlike the off-line experiment of Chinese speaker children (described in Chapter 2, Section 2.2.1), which was carried out by another group of participants.

Table 3-2 shows the results of the off-line experiment. There are five subject control verbs and five object control verbs in one list. Since there are sixteen participants in this experiment, the total number of subject control verbs is eighty (5 verbs × 16 participants), and that of object control verbs is also eighty (5 verbs × 16 participants).
Table 3-2: Number of acquired verbs (AV) and unacquired verbs (UV)

<table>
<thead>
<tr>
<th></th>
<th>First Grade</th>
<th></th>
<th>Second Grade</th>
<th></th>
<th>Third Grade</th>
<th></th>
<th>Fourth Grade</th>
<th></th>
<th>Fifth Grade</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AV</td>
<td>UV</td>
<td>AV</td>
<td>UV</td>
<td>AV</td>
<td>UV</td>
<td>AV</td>
<td>UV</td>
<td>AV</td>
<td>UV</td>
</tr>
<tr>
<td>Subject control verb</td>
<td>33</td>
<td>47</td>
<td>44</td>
<td>36</td>
<td>68</td>
<td>12</td>
<td>75</td>
<td>5</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>Object control verb</td>
<td>17</td>
<td>63</td>
<td>20</td>
<td>60</td>
<td>37</td>
<td>43</td>
<td>57</td>
<td>23</td>
<td>73</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>110</td>
<td>64</td>
<td>96</td>
<td>105</td>
<td>55</td>
<td>132</td>
<td>28</td>
<td>153</td>
<td>7</td>
</tr>
</tbody>
</table>

Next, I will discuss the results for each word order (i.e., SOV and OSV) condition. The two word orders are discussed separately, mainly because the nearest noun phrase (filler) from the empty subject differs in the two word orders.

3.1.3  **SOV word order**

3.1.3.1 **Prediction**

Unacquired verbs

From the result of the off-line experiment (Table 3-2), it is known that the acquisition level of the experimental verbs (such as *ibatta* and *susumeta*) is low in the lower classes (first graders 50/160=31.3% and second graders 64/160=40%). In the third and fourth grades, the ratio of matrix verb acquisition is more than 50% (third graders 105/160=65.6% and fourth graders 132/160=82.5%). Fifth graders had almost acquired all control information of the experimental verbs (153/160=95.6%).

When lexical information on the verb had not been acquired, nothing could be done on the judgment of PRO. If no strategy is employed at all, the number of YES and NO responses to the question "Kenji will buy a personal computer" would be about the same, and the number of
YES and NO responses to the question “Mari will buy a personal computer” would also be about the same.

As discussed in Chapter 2, various possibilities are available with regard to the insignificant difference: the children do not use any strategies completely, or some competing strategies are used randomly, strategies used may differ due to individual variations, or depending on the experimental sentences. Therefore, I will study the overall data, but not the data of individuals. If the result turns out to be not significant, there are two possibilities: participants do not use any strategies completely, or some competing strategies are used randomly.

If participants do employ some strategies to “guess” the sentence, the only means is to use the information of nouns with a case particle.

i): Perceptual strategy – recency strategy

If participants use a general-purpose strategy such as the recency strategy, which predicts that “an empty subject is filled with the nearest filler (Mari-san)”, participants should prefer to fill the empty subject with NP2 (Mari-san). Therefore, the number of YES responses to the question sentence “Mari will buy a personal computer.” for subject control sentences should increase. This would be a direct indication of the recency strategy. Furthermore, it would be expected that NO responses to the question sentence “Kenji will buy a personal computer.” for object control sentences should increase. This could be an indirect and secondary indication of the recency strategy, because the rejection of NP1 (Kenji-kun) indirectly supports NP2 preference.
ii): Perceptual strategy – primacy strategy

If participants use a general-purpose strategy such as the primacy strategy, which predicts that “an empty subject is filled with the filler at the beginning of the sentence (Kenji-kun)”, participants should prefer to fill the empty subject with Kenji-kun. The YES responses to the question sentence “Kenji will buy a personal computer.” for subject control sentences and the number of the NO responses to the question sentence “Mari will buy a personal computer.” for object control sentences should increase.

iii): Linguistic strategy – case-marker ga preference

If the nominative information of the case-marker ga is preferred by the participants because of its prominence, Kenji-kun, which is attached with the case-marker ga, would fill the empty subject with a high priority. The YES responses to the question sentence “Kenji will buy a personal computer.” for subject control sentences and the number of the NO responses to the question sentence “Mari will buy a personal computer.” for object control sentences should increase.

Summary

Recency strategy and primacy strategy are “Perceptual strategies”, while case-marker ga preference is a type of “Linguistic strategy”. The predictions of the unacquired verbs are shown in the following table.
Table 3-3: Predictions of the unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>no strategy employed</th>
<th>YES responses = NO responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>some strategies employed</td>
<td>perceptual strategies</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>linguistic strategy</td>
<td>case-marker preference ga</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Acquired verbs

When the participants read the experimental sentences with an acquired matrix verb, the correct rate should be high. It is predicted that empty subject sentences with an acquired matrix verb are processed in a manner similar to adults, who can classify the sentence type correctly.

In the empty subject sentence processing studies (Oda et al. 1997, Ninose et al. 1998) that used the same 'recognition task' on adult participants, a "subject preference" effect (the grammatical subject is preferred as the candidate for the empty subject) was shown, as stated in chapter 1. Thus, if the participants use the control information from the matrix verb as good as adults, the empty subject would be filled by the subject (Kenji-kun) initially. When the matrix verb is shown, re-analysis would be needed if the matrix verb is an object control verb, but not for a subject control verb. Due to this reanalysis, the reading times (RT's) of the object control verbs should be longer than that of subject control verbs. The predictions of acquired verbs are shown below.
Table 3-4: Predictions of RTs and correct answer for the acquired verbs in SOV order

<table>
<thead>
<tr>
<th></th>
<th>(41a) &lt; (41b)</th>
<th>Percentage of correct answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTs of P5</td>
<td></td>
<td>high</td>
</tr>
</tbody>
</table>

3.1.3.2 Results and discussion

Unacquired verbs

Here, I am interested in the pattern of responses when the verbs are not acquired by the children. Would they rely on case information if the control sentences involved unacquired verbs? Or, would they use distance or position information instead?

First grade

The results of first graders, who had not acquired almost all matrix verbs, are shown below.

Table 3-5: Questions and YES/NO responses by first graders on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, distant filler)</td>
<td>31 (66%)</td>
<td>16 (34%)</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, recent filler)</td>
<td>30 (48%)</td>
<td>33 (52%)</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>61</td>
<td>49</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

(Fisher’s exact test: .05 < p < .10)

Table 3-5 shows that there is a significant tendency between responses given to subject
control sentence questions and object control sentence questions (Fisher’s exact test, n=110, \(p=0.0805\)). Although the preferential bias for NP1 (Kenji-kun) is found among first graders, the difference only shows a significant tendency, and do not reach a significant difference. At first glance, it may seem that first graders employed no strategies to process the sentences. However, the first graders in Japan are older than the first graders in China for seven months (also see Chapter 2.2.2.2, the average age of first graders in China is 6.11, while the average age of first graders in Japan is 7.6, see 3.1.2). Moreover, first graders have better knowledge of matrix verbs and higher cognitive ability than the first graders in China, it is appropriate to think that first graders did employ some strategies to “guess” the sentences.

The above results confirm the prediction that first graders would use either the recency strategy, primacy strategy, or the nominative information of case-marker ga. Recency strategy enhances the NP2 (Mari-san) preference, while the case-maker ga and the primacy strategy makes NP1 (Kenji-kun) more salient. Competition between the two resulted in an insignificant difference between the YES/NO responses. The strategies employed in first grade for the SOV word order are shown below.

(42) Strategies used by first graders for unacquired verbs in SOV order:

a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy

b. perceptual strategy: recency strategy + linguistic strategy: case-marker ga preference

Second grade

The results of second graders for the SOV word order are shown below.
Results from second graders show a significant difference between responses given to subject control sentence questions and object control sentence questions (Fisher’s exact test, n=96, \( p = 0.0196, p < 0.05 \)). The ratio of YES responses for subject control sentence questions (69%) is higher than the ratio of YES responses for object control sentence questions (43%), as shown in Table 3-6. NP1 \((Kenji-kun)\) preference is found in second graders. Furthermore, the number of YES responses is significantly higher than NO responses with regard to the question “Kenji will buy a personal computer.” (YES 25 vs. NO 11). This also supports the view that NP1 \((Kenji-kun)\) is preferred to fill the empty subject.

Therefore, it seems that the case-maker \(ga\) or the primacy strategy, but not the recency strategy, is prominent at this stage. The strategies employed in second grade for the SOV word order are shown below.

\[(43)\] Strategies used by second graders for unacquired verbs in SOV order:

a. perceptual strategy: primacy strategy

b. linguistic strategy: case-maker \(ga\) preference
Third grade

The results of third graders for the SOV word order are shown below.

Table 3-7: Questions and YES/NO responses by third graders on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, distant filler)</td>
<td>9 (75%)</td>
<td>3 (25%)</td>
<td>12</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, recent filler)</td>
<td>23 (53%)</td>
<td>20 (47%)</td>
<td>43</td>
</tr>
<tr>
<td>total</td>
<td>32</td>
<td>23</td>
<td>55</td>
</tr>
</tbody>
</table>

(Fisher's exact test: $p = .2085$, n.s.)

There is no significant difference between the YES/NO responses and sentence question type (Fisher’s exact test, $n=55$, $p = .2085$), as shown in Table 3-7. From this result, it seems that third graders did not employ any strategies to “guess” the empty subject sentences. However, third graders had better knowledge of matrix verbs and a higher cognitive ability, it is appropriate to think that third graders did employ some strategies to “guess” the sentences. The third graders might have used either the recency strategy, primacy strategy, or the nominative information of case-marker ga. The primacy strategy or the case-maker ga enhances NP1 (Kenji-kun) preference, while the recency strategy strengthens NP2 (Mari-san). Competition is the reason why the difference between YES/NO responses was not significant. The strategies employed in third grade for the SOV word order are shown below.
Strategies used by third graders on unacquired verbs in SOV order:

- perceptual strategy: recency strategy + perceptual strategy: primacy strategy
- perceptual strategy: recency strategy + linguistic strategy: case-maker ga preference

Fourth grade

The results of fourth graders for the SOV word order are shown below.

Table 3-8: Questions and YES/NO responses by fourth graders on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>Subject NP of question sentence</th>
<th>YES</th>
<th>NO</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, distant filler)</td>
<td>4 (80%)</td>
<td>1 (20%)</td>
<td>5</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, recent filler)</td>
<td>14 (61%)</td>
<td>9 (39%)</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>10</td>
<td>28</td>
</tr>
</tbody>
</table>

(Fisher's exact test: $p = .6263$, n.s.)

There is also no significant difference between the YES/NO responses and sentence question type (Fisher's exact test, $n=28$, $p = .6263$), as shown in Table 3-8. There is only a few numbers of data on subject control sentence questions (five), I will compare the results with the results of acquired verbs by fourth graders in the following sections.

Fifth grade

The results of fifth graders for the SOV word order are shown below.
Table 3-9: Questions and YES/NO responses by fifth graders on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, distant filler)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, recent filler)</td>
<td>4 (57%)</td>
<td>3 (43%)</td>
<td>7</td>
</tr>
<tr>
<td>total</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p=0.9999$, n.s.)

There is no significant difference between the YES/NO responses and sentence question type (Fisher’s exact test, $n=7$, $p=0.9999$), as shown in Table 3-9. Because the number of data is few, again, I will compare these results with those of acquired verbs.

Acquired verbs

As discussed above, the results of fourth and fifth graders did not show any significant difference when they processed sentences with unacquired matrix verbs. One reason is that there are more acquired matrix verbs than unacquired at these stages. That is, the size of data for unacquired verbs is too small to be relied on. Thus, for these groups, the data of acquired verbs (Table 3-10) should be considered.
Table 3-10: Percentage of correct answers for acquired verbs in SOV order

<table>
<thead>
<tr>
<th></th>
<th>First Grade</th>
<th>Second Grade</th>
<th>Third Grade</th>
<th>Fourth Grade</th>
<th>Fifth Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject control sentence</td>
<td>24/33=72.7%</td>
<td>35/44=79.5%</td>
<td>48/68=70.6%</td>
<td>61/75=81.3%</td>
<td>64/80=80%</td>
</tr>
<tr>
<td>Object control sentence</td>
<td>9/17=52.9%</td>
<td>8/20=40%</td>
<td>21/37=56.8%</td>
<td>41/57=71.9%</td>
<td>49/73=67.1%</td>
</tr>
<tr>
<td>t test</td>
<td>t_{(15)}=5.58, p&lt;.005</td>
<td>t_{(15)}=5.07, p&lt;.001</td>
<td>t_{(15)}=1.7, p=.107 n.s.</td>
<td>t_{(15)}=1.3, p=.201 n.s.</td>
<td>t_{(15)}=2.3, p&lt;.05</td>
</tr>
</tbody>
</table>

Table 3-10 is the percentage of correct answers for acquired verbs. This table shows how correctly the participants responded. The children are on their way developing their knowledge of the lexical property of control verbs. Thus, their responses could have been unstable even if they claimed they “knew” the verbs. Basically, subject control sentences are responded more correctly than object control sentences. There is a significant difference in first graders (72.7% vs. 52.9%), second graders (79.5% vs. 40%) and fifth graders (80% vs. 67.1%). Significant difference is not observed in third graders (70.6% vs. 56.8%) and fourth graders (81.3% vs. 71.9%).

From Table 3-10, although fifth grade children knew both subject/object control verbs, the percentage of correct answers is significantly different between subject/object control sentences (subject control (80%), object control (67.1%)). This result is possibly caused by the “subject preference” effect. The percentage of correct answers is not significant in third and fourth graders. It can be viewed that the parsing strategy employed by children in these grades are different from that of fifth graders.

Next, I will discuss whether the RTs of subject control verbs is shorter than that of object control verbs, and whether the participants would yield similar results as adults when they read
sentences with an acquired matrix verb. Figure 3-1 shows the RTs of each phrase in the SOV word order for acquired verbs by fifth graders. Because the matrix verbs used for the experimental sentences are different in the number of moras and characters (e.g., 約束した yakusokushita ‘promised’: mora 6; character 4, 求めた motometa ‘demanded’: mora 4, character 3), per mora and per character of acquired matrix verbs are measured. The results are shown in Table 3-11. The experiment on grade-schoolers in Japan is different from that on grade-schoolers in China, and the same participants participated in both the off-line and on-line experiments. Therefore, the acquired verbs and the unacquired verbs can be discussed separately. Then, the results on the RTs of acquired matrix verbs are able to be shown in Japan from first grade to fifth grade.

![Figure 3-1: RTs of each phrase in SOV order for acquired verbs by fifth graders](image)

Figure 3-1: RTs of each phrase in SOV order for acquired verbs by fifth graders
Table 3-11 shows the RTs (per mora and per character) of acquired matrix verbs. This table shows how fast the participants responded. Basically, the RTs of the object control verb is longer than that of the subject control verb both in mora and character. However, a significant difference in the RTs of the matrix verb is only observed in third graders (185ms vs. 304ms; 222ms vs. 350ms) both in mora and character, but not in first graders (370ms vs. 464ms; 370ms vs. 487ms), second graders (332ms vs. 330ms; 353ms vs. 371ms), fourth graders (292ms vs. 308ms; 359ms vs. 386ms) and fifth graders (220ms vs. 250ms; 275ms vs. 319ms).

These results are not consistent with the prediction that the elder children (fourth and fifth graders) have “subject preference”. It seems that third graders preferred NP1 (subject, the case maker ga, at the beginning of the sentence) to fill the empty subject. That is, third graders filled the empty subject with NP1 at first, when the matrix verb is input, reanalysis is necessary for object control verbs but not for subject control verbs, making the RTs of object control verbs longer. As for fourth and fifth graders, a similar process is not observed. Based on the results of

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mora</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S-control verb</td>
<td>O-control verb</td>
</tr>
<tr>
<td>First</td>
<td>370ms</td>
<td>464ms</td>
</tr>
<tr>
<td></td>
<td>t(8)=.76,</td>
<td>t(8)=1.29,</td>
</tr>
<tr>
<td>Second</td>
<td>332ms</td>
<td>330ms</td>
</tr>
<tr>
<td></td>
<td>t(8)=1.0,</td>
<td>t(8)=1.3,</td>
</tr>
<tr>
<td>Third</td>
<td>185ms</td>
<td>304ms</td>
</tr>
<tr>
<td></td>
<td>t(12)=3.7,</td>
<td>t(12)=2.4,</td>
</tr>
<tr>
<td>Fourth</td>
<td>292ms</td>
<td>308ms</td>
</tr>
<tr>
<td></td>
<td>t(15)=.62,</td>
<td>t(15)=.88,</td>
</tr>
<tr>
<td>Fifth</td>
<td>220ms</td>
<td>250ms</td>
</tr>
<tr>
<td></td>
<td>t(15)=1.41,</td>
<td>t(15)=1.3,</td>
</tr>
</tbody>
</table>

Table 3-11: RTs of acquired verbs (per mora and per character) in SOV order
acquired verbs in the SOV word order, the strategies used in third, fourth and fifth are shown below.

Table 3-12: Strategies used by third, fourth and fifth graders for acquired verbs in SOV order

<table>
<thead>
<tr>
<th></th>
<th>From percentage of correct answers</th>
<th>From RTs of matrix verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third grade</td>
<td>not clear</td>
<td>i) linguistic strategy: case-maker ga preference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) linguistic strategy: subject preference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) perceptual strategy: primacy strategy</td>
</tr>
<tr>
<td>Fourth grade</td>
<td>not clear</td>
<td>not clear</td>
</tr>
<tr>
<td>Fifth grade</td>
<td>linguistic strategy: subject preference</td>
<td>not clear</td>
</tr>
</tbody>
</table>

In conclusion, first graders used different “Perceptual strategies” (e.g., recency strategy or primacy strategy) randomly, or “Perceptual strategies” (e.g., recency strategy) and “Linguistic strategies” (e.g., the case-maker ga) randomly. Either “Perceptual strategies” (e.g., primacy strategy) or “Linguistic strategies” (e.g., the case-maker ga) became prominent in second graders. NP1 preference is observed among third graders in the RTs of matrix verbs (Table 3-11), but not in the percentage of correct answers (Table 3-10). From the results of the SOV word order, it is not clear what strategies are used in the fourth grade. Fifth graders exhibit the “subject preference” effect in the percentage of correct answers (Table 3-10), but not in the RTs of matrix verbs (Table 3-11).

Since we cannot exclude the possibility that first graders used “Linguistic strategies” (even if the use is random), we cannot conclude that the DSPS hypothesis applies to the SOV
order in Japanese. Here, we should note that the noun phrase with case-maker *ga* is at the beginning of the sentence in the SOV order. That the first NP is preferred as the filler can be a possible explanation for the strategy employed by first graders (i.e., primacy strategy). In order to test whether the preference is due to the “Linguistic strategy” that prefers a case maker *ga* NP or the primacy strategy that is related to a specific position, experimental sentences in the OSV word order is needed. Moreover, in the OSV word order, we try to verify some strategies that have not been clarified for third, fourth and fifth grades in the SOV word order. Next, I will introduce the results for the OSV word order.

3.1.4 *OSV word order*

3.1.4.1 *Prediction*

**Unacquired verbs**

The noun phrase attach with the case-maker *ga* (NP1: *Kenji-kun-ga*), which appears at the beginning of the sentence of the SOV word order, become the nearest filler in the OSV word order.

As discussed above, when participants process sentences containing unacquired verbs, if no strategy is employed at all, the number of YES and NO responses to the question “*Kenji will buy a personal computer.*” would about the same, and the same could be said about the question “*Mari will buy a personal computer.*”. Also, the insignificant difference between the YES/NO responses may be attributed to the competing strategies. If participants do employ some strategies to “guess” the sentence, the only means is to use the information from nouns with a case particle.
i): Perceptual strategy – recency strategy

If the participants use a general-purpose strategy such as the recency strategy, “an empty subject is filled with the nearest filler (Kenji-kun)”, they should prefer to fill the empty subject with Kenji-kun. Therefore, it is expected that there would be more YES responses to the question “Kenji will buy a personal computer.” than the question “Mari will buy a personal computer.”, because NP1 is the nearest filler to PRO. Furthermore, we would also expect more NO responses to the question “Mari will buy a personal computer.” than the question “Kenji will buy a personal computer.” since NP2 is the distant filler from PRO in the OSV word order.

ii): Perceptual strategy – primacy strategy

If the primacy strategy is effective to the participants, then the sentence initial element (NP2: Mari-san) would be preferred to fill the empty subject. Thus, the YES responses to the question sentence “Mari will buy a personal computer.” are expected to rise. Furthermore, the NO responses to the question sentence “Kenji will buy a personal computer.” would increase as well.

iii): Linguistic strategy – case-marker ga preference

If the nominative information of the case-marker ga is preferred by the participants, the noun phrase Kenji-kun with the case-marker ga attached would be used to fill the empty subject with a high priority, and the NP1 preference to the question sentence “Kenji will buy a personal computer.” would increase. This is a direct indication of case-marker ga preference. As an indirect and secondary indication, the NO responses (NP2-rejection) to the question sentence “Mari will buy a personal computer.” are also expected to increase, because NP2 (Mari-san) is not attached with the case-maker ga.
Summary

The recency strategy and primacy strategy are "Perceptual strategies", while the use of case-marker *ga* preference is a type of "Linguistic strategy". The predictions of the processing of sentences with unacquired verbs in the OSV word order are shown in the following table.

<table>
<thead>
<tr>
<th>No strategy employed</th>
<th>YES responses = NO responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Some strategies employed</td>
<td>perceptual strategies</td>
</tr>
<tr>
<td></td>
<td>recency strategy</td>
</tr>
<tr>
<td></td>
<td>YES NP1 (Kenji-kun) &gt; YES NP2 (Mari-san)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Kenji-kun) &lt; NO NP2 (Mari-san)</td>
</tr>
<tr>
<td></td>
<td>primacy strategy</td>
</tr>
<tr>
<td></td>
<td>YES NP1 (Kenji-kun) &lt; YES NP2 (Mari-san)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Kenji-kun) &gt; NO NP2 (Mari-san)</td>
</tr>
<tr>
<td></td>
<td>linguistic strategy</td>
</tr>
<tr>
<td></td>
<td>case-marker <em>ga</em> preference</td>
</tr>
<tr>
<td></td>
<td>YES NP1 (Kenji-kun) &gt; YES NP2 (Mari-san)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Kenji-kun) &lt; NO NP2 (Mari-san)</td>
</tr>
</tbody>
</table>

Acquired verbs

When the participants read the experimental sentences with an acquired matrix verb, the prediction is the same as that of the SOV word order. The correct answer rate is expected to be high. It is assumed that the participants processed empty subject sentences with acquired matrix verbs in a similar manner to adults, who can correctly classify the sentence type.

Thus, if the participants use "subject preference" strategy as good as adults, the empty subject would be filled by the subject at first. When the matrix verb is shown, reanalysis would be needed if the matrix verb is an object control verb, but not when it is a subject control verb. Due to this reanalysis, the RTs of object control verbs would therefore be longer than that of subject control verbs.
3.1.4.2 Results and discussion

It is interesting to see whether the opposite result would be obtained when the word order is changed. If NP2 (Mari-san) become the sentence initial filler, and NP1 (Kenji-kun) become nearer to PRO, would this cause a change in the result?

First grade

The results of first graders for the OSV word order are shown below.

Table 3-15: Questions and YES/NO responses by first graders on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td>35 (74%)</td>
<td>12 (26%)</td>
<td>47</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td>36 (57%)</td>
<td>27 (43%)</td>
<td>63</td>
</tr>
<tr>
<td>total</td>
<td>71</td>
<td>39</td>
<td>110</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: 0.05 < p < 0.10)

Table 3-15 shows that there is a significant tendency of difference between responses given to subject control sentence questions and object control sentence questions (Fisher’s exact test, n=110, p=0.0716). As discussed above, the first graders in Japan are older than the first graders in China for seven months. Moreover, first graders have better knowledge of matrix
verbs and higher cognitive ability than the first graders in China, it is appropriate to think that first graders did employ some strategies to “guess” the sentences.

From above results, first graders might have employed both ‘recency strategy + primacy strategy’, where recency strategy strengthened NP1 preference and primacy strategy enhanced NP2 preference. Also, ‘primacy strategy + case-maker ga preference’ could be another possibility, because case-maker ga preference could have promoted the NP1 preference while the primacy strategy enhanced NP2 preference. The strategies employed in first grade for the OSV word order are shown below.

(45) Strategies used by first graders for unacquired verbs in OSV order:
   a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy
   b. perceptual strategy: primacy strategy + linguistic strategy: case-maker ga preference

Second grade

The results of second graders for the OSV word order are shown below.

Table 3-16: Questions and YES/NO responses by second graders on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td></td>
<td>26 (72%)</td>
<td>10 (28%)</td>
<td>36</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td></td>
<td>28 (47%)</td>
<td>32 (53%)</td>
<td>60</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>54</td>
<td>42</td>
<td>96</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p<.05$)
Table 3-16 shows a significant difference between responses given to subject control sentence questions and object control sentence questions (Fisher’s exact test, \(n=96, p=0.0194, p<0.05\)). The ratio of YES responses in subject control sentence questions (72%) is higher than the ratio of YES responses in object control sentence questions (47%). This result directly supports NP1 (Kenji-kun) preference. Furthermore, YES responses are higher than NO responses in the subject control sentence questions (YES 26 vs. NO 10). This result also supports NP1 (Kenji-kun) preference.

From the above results, NP1 (Kenji-kun) preference is observed among second graders. Therefore, it seems that the case-maker ga or recency strategy has become prominent at this stage. The strategies employed in second grade for the OSV word order are shown below.

(46) Strategies used by second graders for unacquired verbs in OSV order:
   a. perceptual strategy: recency strategy
   b. linguistic strategy: case-maker ga preference

Third grade

The results of third graders for the OSV word order are shown below.

Table 3-17: Questions and YES/NO responses by third graders on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td>10 (83%)</td>
<td>2 (17%)</td>
<td>12</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td>23 (53%)</td>
<td>20 (47%)</td>
<td>43</td>
</tr>
<tr>
<td>total</td>
<td>33</td>
<td>22</td>
<td>55</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: \(.05<p<.10\))
Table 3-17 shows that there is a significant tendency between responses given to subject control sentence questions and object control sentence questions (Fisher's exact test, \( n=55, \ p=0.0960 \)). Although preferential bias for NP1 \((Kenji-kun)\) is observed, the difference only had a significant tendency, and do not reach a significant difference. From this result, it seems that third graders did not employ any strategies to "guess" the sentences. However, third graders had better knowledge of matrix verbs and a higher cognitive ability, it is appropriate to think that third graders did employ some strategies to "guess" the sentences.

The third graders might have used either the recency strategy, or primacy strategy, or the nominative information of case-marker \(ga\). The recency strategy or case-maker \(ga\) enhanced NP1 \((Kenji-kun)\) preference, while the primacy strategy strengthened NP2 \((Mari-san)\). Competition is the reason why the difference between the YES/NO responses is not significant.

The strategies employed in third grade for the OSV word order are shown below.

(47) Strategies used by third graders for unacquired verbs in OSV order:

a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy

b. perceptual strategy: primacy strategy + linguistic strategy: case-maker \(ga\) preference

Fourth grade

The results of fourth graders for the OSV word order are shown below.
Table 3-18: Questions and YES/NO responses by fourth graders on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td></td>
<td>3 (60%)</td>
<td>2 (40%)</td>
<td>5</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td></td>
<td>8 (35%)</td>
<td>15 (65%)</td>
<td>23</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>11</td>
<td>17</td>
<td>28</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: p = .3530, n.s.)

There is no significant difference between the YES/NO responses and sentence question type (Fisher’s exact test, n=28, p=.3530), as shown in Table 3-18. As there are only a few number of data on subject control sentence questions (five), the results will be compared with that of acquired verbs.

Fifth grade

The results of fifth graders for the OSV word order are shown below.

Table 3-19: Questions and YES/NO responses by fifth graders on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td></td>
<td>4 (57%)</td>
<td>3 (43%)</td>
<td>7</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: p = .9999, n.s.)
There is no significant difference between the YES/NO responses and sentence question type (Fisher’s exact test, n=7, \( p=.9999 \)), as shown in Table 3-19. Since the number of data is small, again, I will discuss the results of acquired verbs below.

Acquired verbs

As discussed above, the results of fourth and fifth graders did not show any significant difference when they processed sentences with unacquired matrix verbs in the OSV word order. The size of data for unacquired verbs is probably too small to be relied on. Thus, for these groups, the data of acquired verbs (Table 3-20) should be considered.

Table 3-20: Percentage of correct answers for acquired verbs in OSV order

<table>
<thead>
<tr>
<th></th>
<th>First Grade</th>
<th>Second Grade</th>
<th>Third Grade</th>
<th>Fourth Grade</th>
<th>Fifth Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject control sentence</td>
<td>26/33=78.8%</td>
<td>33/44=75%</td>
<td>52/68=76.5%</td>
<td>55/75=73.3%</td>
<td>64/80=80%</td>
</tr>
<tr>
<td>Object control sentence</td>
<td>8/17=47.1%</td>
<td>8/20=40%</td>
<td>20/37=54.1%</td>
<td>35/57=61.4%</td>
<td>46/73=63.0%</td>
</tr>
</tbody>
</table>
| \( t \) test          | \( t_{15}=24.8, \)  
\( p<.001 \)  | \( t_{15}=29.9, \)  
\( p<.001 \)  | \( t_{15}=3.0, \)  
\( p<.01 \)  | \( t_{15}=.78, \)  
\( p=.446 \text{ n.s.} \) | \( t_{15}=2.7, \)  
\( p<.05 \)  |

Table 3-20 is the percentage of correct answers to questions for acquired verbs in the OSV order. All groups except fourth graders show a significant difference between subject control sentences and object control sentences. The correct answer rate of subject control sentences is higher than that of the object control sentences. Same as the SOV order, the correct rate of first graders and second graders would have been influenced by the unacquired verbs as they had limited knowledge about the matrix verbs. The results of third and fifth graders are
possibly influenced by the "subject preference" effect.

The percentage of correct answers shows the same tendency with the SOV order. Even when the word order is different, the correct answer rate to questions of subject control sentences is higher than that of object control sentences.

Next, I will discuss whether the RTs of subject control verbs is shorter than object control verbs, and whether the participants had adult-like performance when they read sentences with an acquired verb. Figure 3-2 shows the RTs of each phrase in the OSV word order for acquired verbs by fifth graders. As discussed above, because the matrix verbs used for the experimental sentences are different in the number of moras and characters (e.g., 約束した yakusokushita ‘promised’: mora 6, character 4, 求めた motometa ‘demanded’: mora 4, character 3), per mora and per character of acquired matrix verbs are measured. The results are shown in Table 3-21.

Figure 3-2: RTs of each phrase in OSV order for acquired verbs by fifth graders
Table 3-21: RTs of acquired verbs (per mora and per character) in OSV order

<table>
<thead>
<tr>
<th></th>
<th>mora</th>
<th>character</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S-control verb</td>
<td>O-control verb</td>
<td>S-control verb</td>
<td>O-control verb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First  grade</td>
<td>345ms</td>
<td>432ms</td>
<td>345ms</td>
<td>462ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second grade</td>
<td>298ms</td>
<td>359ms</td>
<td>323ms</td>
<td>395ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third grade</td>
<td>228ms</td>
<td>240ms</td>
<td>274ms</td>
<td>291ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth grade</td>
<td>309 ms</td>
<td>383ms</td>
<td>376ms</td>
<td>478ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifth grade</td>
<td>215 ms</td>
<td>304ms</td>
<td>265ms</td>
<td>387ms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3-21 is the RTs of the acquired matrix verbs, per mora and per character. Significant difference in the RTs of the matrix verb is observed in the fifth grade, both per mora and per character. In the fourth grade, the difference of the matrix verb is significant only in the character measure, and is marginally significant in the mora measure.

These results are different from the SOV order. A significant difference is observed in fourth grader in character, fifth graders both in the mora and character. These results show that the fourth and fifth graders might have employed "subject preference" to process the sentence.

From the results of percentage of correct answers and RTs of the matrix verbs about acquired verbs in the OSV word order, the strategies used by the third, fourth and fifth graders are shown below.
Table 3-22: Strategies used by third, fourth and fifth graders for acquired verbs in OSV order

<table>
<thead>
<tr>
<th></th>
<th>From percentage of correct answers</th>
<th>From RTs of matrix verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third grade</td>
<td>linguistic strategy: subject preference</td>
<td>not clear</td>
</tr>
<tr>
<td>Fourth grade</td>
<td>not clear</td>
<td>linguistic strategy: subject preference</td>
</tr>
<tr>
<td>Fifth grade</td>
<td>linguistic strategy: subject preference</td>
<td>linguistic strategy: subject preference</td>
</tr>
</tbody>
</table>

In conclusion, data from the OSV word order shows that first graders use different “Perceptual strategies” (e.g., recency strategy or primacy strategy) randomly, or “Perceptual strategies” (e.g., primacy strategy) and “Linguistic strategies” (e.g., the case-maker ga) randomly. Either “Perceptual strategies” (e.g., primacy strategy) or “Linguistic strategies” (e.g., the case-maker ga) became prominent in second graders. ‘Subject preference’ is observed among third graders in the percentage of correct answers (Table 3-20), but not the RTs of matrix verbs (Table 3-21). On the other hand, ‘subject preference’ is seen in fourth graders in the RTs of matrix verbs (Table 3-21), but not the percentage of correct answers (Table 3-20). Fifth graders exhibited the “subject preference” effect both in the percentage of correct answers (Table 3-20) and RTs of matrix verbs (Table 3-21).

In the following paragraph, I will provide an overall discussion on the results of the SOV and OSV word orders.

3.1.5 General discussion from SOV and OSV orders

First grade

First graders had not acquired almost all of the matrix verbs in the experimental sentences.
The ratio of YES responses for NP1 (Kenji-kun, distant filler, at the beginning of the sentence, the case-maker ga) (66%) is higher than NP2 (Mari-san, recent filler) (48%) in the SOV word order. Moreover, the ratio of YES responses for NP1 (Kenji-kun, recent filler, the case-maker ga) (74%) is higher than NP2 (Mari-san, distant filler, at the beginning of the sentence) (57%) in the OSV word order. However, in both cases, the difference only shows a significant tendency, but do not reach a significant difference. Furthermore, the ratio of NO responses for NP2 (Mari-san, recent filler) (52%), i.e., NP1-rejection, is higher than the ratio of NO responses for NP1 (Kenji-kun, distant filler, at the beginning of the sentence, the case-maker ga) (34%), i.e., NP2-rejection. Also, the ratio of NO responses for NP2 (Mari-san, distant filler, at the beginning of the sentence) (43%), i.e., NP2-rejection, is higher than the ratio of NO responses for NP1 (Kenji-kun, recent filler, the case-marker ga) (26%), i.e., NP1-rejection, in the OSV word order. In both cases, the difference only shows a significant tendency, but do not reach a significant difference.

From the results of the SOV word order, I claim that first graders would use either 'recency strategy + primacy strategy', or 'recency strategy + case-marker ga preference' (see (42)). On the other hand, the results of the OSV word order do not support that first graders employed 'recency strategy + case-marker ga preference' (see (45)). Thus, from the results of the SOV and OSV word orders, I conclude that first graders employed "Perceptual strategies" (i.e., 'recency strategy + primacy strategy') to "guess" the sentence. The strategies used by first graders in the SOV and OSV word orders are shown below.

Table 3-23: Summary of first graders’ strategies for SOV and OSV orders

| First grade perceptual strategy: recency strategy + perceptual strategy | primacy strategy |
Second grade

In both the SOV and OSV word orders, the ratio of YES NP1 in subject control sentence questions (SOV word order: 69%, OSV word order 72%) is higher than the ratio of YES NP2 in object control sentence questions (SOV word order 43%, OSV word order 47%), and the ratio of NO NP2 in object control sentence questions (SOV word order 57%, OSV word order 53%) is higher than the ratio of NO NP1 in subject control sentence questions (SOV word order 31%, OSV word order 28%). The result of YES responses shows NP1 (Kenji-kun) preference, which is a direct indication that supports the case-maker ga preference or primacy strategy. On the other hand, the result of NO responses also shows NP1 (Kenji-kun) preference, which is an indirect and secondary indication that supports the case-maker ga preference or primacy strategy. Therefore, it seems that the case-maker ga or primacy strategy, but not the recency strategy, has become prominent at this stage. The strategies used by second graders in the SOV and OSV word orders are shown below.

Table 3-24: Summary of second graders' strategies for SOV and OSV orders

<table>
<thead>
<tr>
<th>Second grade</th>
<th>i) perceptual strategy: primacy strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii) linguistic strategy: case-maker ga preference</td>
</tr>
</tbody>
</table>

Third grade

From the results of the SOV word order, in which the RTs of subject control verbs are shorter than those of object control verbs, third graders might have employed ‘case-maker ga preference’, ‘primacy strategy’ or ‘subject preference’. These factors make third graders fill the empty subject with NP1 at first, but when the matrix verb is input, re-analysis resulted in longer RTs for object control verbs. When they “guessed” sentences with unacquired verbs, third
graders might have employed 'recency strategy + primacy strategy' or 'recency strategy + case-maker ga preference'.

From the results of the OSV word order, the higher percentage of correct answers in subject control sentences show that third graders used 'subject preference' when they processed sentences with acquired verbs. On the other hand, when they "guessed" sentences with unacquired verbs, third graders might have employed 'recency strategy + primacy strategy' or 'primacy strategy + case-maker ga preference'.

From the results of the SOV and OSV word orders, third graders use a combination of 'case-maker ga preference', 'primacy strategy' and 'subject preference' when the sentences included an acquired verb, and use the 'recency strategy' and 'primacy strategy' when the sentences included an unacquired verb. In Japanese, matrix verb appears at the end of the sentence, it works to checking the strategies used in the sentences. In other words, the strategies used at the stage before the matrix verb is input should be consistent, regardless of whether the matrix verb is acquired or not. Because the ratio of acquired matrix verbs by the third graders is high, it is necessary to focus mainly on the strategies of the acquired matrix verbs. Thus, the possibility that the third graders use the 'case-maker "ga" preference', 'primacy strategy' or 'subject preference' is high. The strategies used by third graders in the SOV and OSV word orders are shown below.

Table 3-25: Summary of third graders’ strategies for SOV and OSV orders

<table>
<thead>
<tr>
<th>Third grade</th>
<th>i) perceptual strategy: primacy strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii) linguistic strategy: case-maker ga preference</td>
</tr>
<tr>
<td></td>
<td>iii) linguistic strategy: subject preference</td>
</tr>
</tbody>
</table>
Fourth grade

From the results of the SOV word order, it is not clear what strategies are used. Based on the results of the RTs of matrix verbs in the OSV word order, ‘subject preference’ is seen in the fourth graders. However, this effect only showed up in the results for the characters, and had only a significant tendency in mora. The strategy used by fourth graders in the SOV and OSV word orders is shown below.

Table 3-26: Summary of fourth graders’ strategy for SOV and OSV orders

<table>
<thead>
<tr>
<th>Fourth grade</th>
<th>linguistic strategy: subject preference</th>
</tr>
</thead>
</table>

Fifth grade

In the SOV and OSV word orders, the higher percentage of correct answers shows that the fifth graders could answer the questions correctly. From the higher percentage of correct answers in subject control sentences, fifth graders are deemed to use ‘subject preference’ to process the sentence. This is further verified in the RTs of the matrix verbs. Unfortunately, ‘subject preference’ is only observed in the OSV word order, but not in the SOV word order. Since the parsing cost is higher for the OSV word order than the SOV word order, there is no room to process both at the same time when the matrix verb is input in the OSV order. This explains why the ‘subject preference’ effect easily became prominent. The strategy used by fifth graders in the SOV and OSV word orders is shown below.

9 The ‘-’ sign indicates that the ‘subject preference’ was not strong.
Table 3-27: Summary of fifth graders’ strategy for SOV and OSV orders

<table>
<thead>
<tr>
<th>Fifth grade</th>
<th>linguistic strategy: subject preference</th>
</tr>
</thead>
</table>

The results of the processing of Japanese empty subject sentences by elementary school children suggest that “Perceptual strategies” (i.e., ‘recency strategy’, ‘primacy strategy’) are used by first graders who had not acquired the matrix verbs, while “subject preference” is used by upper graders who had acquired the matrix verbs.

3.2 Concluding remarks

From the results of SOV word order and OSV word order, it is clear that first grade elementary school children, who had not acquired the meaning of matrix verbs and had relatively lower cognitive ability, preferred the use of the ‘recency strategy’ and ‘primacy strategy’ to fill the empty subject. That is, non-linguistic, general-purpose strategies are utilized at the earlier stage of language development.

For second graders, whose cognitive ability is a little more advanced than the first graders, the primacy strategy, but not the recency strategy, and a “Linguistic strategy” (i.e., ‘case-maker *ga* preference’) became prominent. Also, we point out the possibility that with the increase in memory capacity, the effect of primacy may become more pronounced.

Third graders, whose linguistic ability and cognitive ability are more advanced than the lower graders, are able to use the primacy strategy instead of the recency strategy to process the sentence. Both non-linguistic strategy (i.e., ‘primacy strategy’) and linguistic strategies (i.e., ‘case-maker *ga* preference’, ‘subject preference’) are utilized in a combined way.

The fourth graders, who have acquired more matrix verbs than the third graders, are found to use “subject preference”.

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The fifth graders, who have acquired the most matrix verbs, show the same parsing strategy, i.e., ‘subject preference’, as the adults.

The strategies used at different verb acquisition levels are shown below.

Graph 3-1: The results of L1 Japanese

- **The first grade**
  - Perceptual strategies:
    - recency strategy
    - primacy strategy

- **The second grade**
  - Perceptual strategy: primacy strategy
  - Linguistic strategy: case-maker *ga* preference

- **The third grade**
  - Perceptual strategy: primacy strategy
  - Linguistic strategies:
    - case-maker *ga* preference
    - subject preference

- **The fourth grade**
  - Linguistic strategy: subject preference

- **The fifth grade**
  - Linguistic strategy: subject preference

Consequently, the experiments conducted on Japanese children suggest that the parsing strategy shifts from “Perceptual strategies” to “Linguistic strategies” as children acquire more linguistic knowledge. This is another piece of strong evidence that supports the DSPS hypothesis.

Chapters 2 and 3 discussed the DSPS hypothesis from the aspect of first language acquisition of Chinese and Japanese. First graders in China used the recency strategy, while
Japanese first graders used the recency strategy and primacy strategy to “guess” the control sentences with unacquired verbs. First graders in Japan seem to use the primacy strategy at an earlier stage than those in China. There is a difference of half a year in the average age due to the half-year lag in the new school term in China as compared to Japan (also see Chapter 2.2.2.2, the average age of first graders in China is 6.11, while the average age of first graders in Japan is 7.6). Furthermore, the experiment is done at the end of the school term in Japan (February) but at the beginning of the school term in China (March). Due to the age difference and the difference in the content of education, first graders in Japan might have come to use the primacy strategy earlier.

In both cases, it is interesting that the recency strategy is used earlier than the primacy strategy both in the children of Japan and China. It seems that the primacy strategy requires that the cognitive ability be developed to a certain degree. Primacy strategy is related to the memory capacity, and therefore it may not be easy to utilize it at an early stage.

In the second grade, a special grammatical strategy is used (i.e., ‘the verb shuo’ in Chinese and ‘case-maker ga preference’ in Japanese)\(^\text{10}\). Third and fourth graders used the same strategies as adults, while using “Perceptual strategies” at the same time. Fifth graders used the same strategy as adults to process the sentences.

Below is a summary of results from Chinese and Japanese school children.

\(^{10}\) These strategies are called linguistic strategies, but are not strategies used by adults.
Graph 3-2: The results of L1 Chinese and L1 Japanese

The first grade
- Perceptual strategies:
  - recency strategy
  - primacy strategy (Japanese)

The second grade
- Perceptual strategies:
  - recency strategy (Chinese)
  - primacy strategy (Japanese)
- Linguistic strategies:
  - the verb *shuo* (Chinese)
  - case-maker *ga* preference (Japanese)

The third grade
- Perceptual strategy: primacy strategy
- Linguistic strategies:
  - the verb *shuo* (Chinese)
  - case-maker *ga* preference (Japanese)
  - subject preference (Japanese)

The fourth grade
- Perceptual strategy: primacy strategy (Chinese)
- Linguistic strategies:
  - the verb *shuo* (Chinese)
  - using control information on verb (Chinese)
  - case-maker *ga* preference (Japanese)
  - subject preference (Japanese)

The fifth grade
- Linguistic strategies:
  - immediate use of the control information of the verb (Chinese)
  - subject preference (Japanese)
“Perceptual strategies” are used by Chinese and Japanese first graders. “Linguistic strategies” are available from the second grade both in Chinese and Japanese children. Once the matrix verbs are acquired, the parsing strategy becomes similar to that of adults. With the development of cognitive ability, the tendency that the “guess” process moves from the recency strategy to primacy strategy is shown both in Chinese and Japanese children.

Does the shift of “guessing” processes apply to L2 learners as well? The participants are adults in L2, whose cognitive ability is well-developed. Are “Perceptual strategies” also observed in the stage before the matrix verbs are acquired in L2 acquisition? If the results of L2 are different from that of L1, could it be due to an influence of the interference with their first language? In the following chapters, we will verify the universality of the DSPS hypothesis from the perspective of second language acquisition.
Chapter 4: Processing subject control sentences among L1 English / L2 Chinese learners

Based on two experiments conducted on Chinese (Chapter 2) and Japanese (Chapter 3) children, I proposed the “Developmental Shift of Parsing Strategies (DSPS)” hypothesis, and clarified the process at the different levels of verb acquisition. Lower grade children, due to their relatively lower cognitive ability, prefer using non-linguistic strategy or general-purpose strategy (i.e., ‘recency strategy’, ‘primacy strategy’) to fill the empty subject. “Linguistic strategy” is used by children at a later stage of language development when the matrix verbs have been acquired.

This chapter describes an attempt to test if the DSPS hypothesis is a universal hypothesis. If it is, it should be observed in second language acquisition as well. Second language learners, unlike grade-schoolers, are well-developed in their cognitive ability. In this case, it is interesting to know whether “Perceptual strategies” will be used when the L2 learners process sentences including unacquired matrix verbs. What causes the use of “Perceptual strategies”: the lower cognitive ability or insufficient linguistic knowledge? If results different from L1 are obtained for L2 learners, what would be the cause of this difference? Is it due to influences by their first language?

If the DSPS hypothesis is a universal hypothesis, despite having higher cognitive abilities, L2 learners of lower proficiency will tend to use general strategies, such as the ‘recency strategy’ or ‘primacy strategy’, just like a child who is acquiring first language, while those with higher proficiency will tend to employ more linguistic strategies in comprehension.

In section 4.1, I will introduce some research and theoretical issues in second language acquisition. In section 4.2, I describe an experiment for testing whether English native speakers...
learning Chinese shift their parsing strategies as they make progress in their language skills. In section 4.3, I discuss the applicability of the DSPS hypothesis to L2 learners.

4.1 Research and Theoretical issues in Second Language (L2) Acquisition

Research that deals with the properties of the acquisition and development of a language other than one's first language is considered second language (L2) acquisition research. A common observation in studies of first language (L1) acquisition is that children acquire a language apparently flawlessly in a relatively short time, and acquire rich knowledge of their language which surpasses their actual experience. With regard to L1 acquisition, Chomsky (1959) claim that language acquisition is the result of the maturation of an innate neurophysiological program. This maturation is said to be governed by the Universal Grammar, the kernel part of the Language Acquisition Device, where an innate neurophysiological program can be found (see Chapter 2).

It is after 1950's when L2 acquisition is first being studied systematically under theoretical linguistics. The developing process can be roughly divided into three stages.

In the first stage from the 1950's to the beginning of the 1960's, L2 acquisition research had implications in language education, and was strongly influenced by Structuralism (Bloomfield 1933) and Behaviorism Psychology (Skinner 1957). Language Learning is considered a kind of habit formation that based on stimulation from the environment and the reaction to the stimulation. The learning of a second language is considered a process to replace formed habits in one's first language by forming new habits in the second language. Thus it is important to imitate the structural pattern of the target language repeatedly. Moreover, for effective education, there is a necessity to predict what is difficult and what is not for the learners. Contrastive analysis that clarified the difference between the first language and the
second language (difficulty) and common features (easiness) became active (Fries 1945, Lado 1957, 1964). Lado (1957) says, "we assume that the student who comes in contact with a foreign language will find some features of it quite easy and others extremely difficult. Those elements that are similar to his first language will be simple for him, and those elements that are different will be difficult (Lado 1957, p.2)." In other words, the acquisition of L2 is to suppress the influence from L1.

In the second stage, from the latter half of the 1960's to the 1970's, the focus shifted to the language constructed by the learners themselves. For example, the theory of cognitive development (Piaget 1970) shifted the attention from Behaviorism Psychology to the power of the child prepared internally. The Generative Grammar by Chomsky (1959) focused on the issue of language creativity and language acquisition. In contrast, first language acquisition in the 1970's centered on the research concerning the acquisition of grammatical morphemes (Brown 1973). The shift of theoretical focus was parallel to that of second language acquisition research, as predictions by the contrastive analysis are found inaccurate. The focus then shifted to what learners produce voluntarily in L2 acquisition. There is research on grammatical morpheme acquisition in both first and second language acquisition. It is confirmed that there is a common order of acquisition and developmental stage in L2, though the order differed from that of L1 (Dulay & Burt 1973, 1974). Moreover, contrastive analysis is replaced by error analysis. It is assumed that mistakes are reflection of the grammar that a learner had hypothesized based on the target language. Clarifying learners' internal characteristics through the analysis of mistakes became the goal of the second language acquisition research. It is observed that the grammar produced by learners is different from that of both the target language and the first language, though it could be described as a dynamic system that follows a set of rules. Selinker (1972) called it the "interlanguage (IL)". Monitor model, which exerted a
large influence on didactics, is proposed and refined from the latter half of the 1970's to the 1980's in the background of such research as Krashen 1981, 1982, 1985. Although research at this time assumed universal characteristics among learners, it is by and large descriptions of the acquisition order. It lacked a theoretical account on the existing orders.

In the third stage, starting from the middle of the 1980's, L2 acquisition research parted from didactics, and looked for a practicable effect. The main focus became providing theoretical explanations to the acquisition process. It can be said that the theoretical basis of L2 acquisition research grounded on the Generative Grammar theory. The research question, then, became whether and how Universal Grammar, the kernel part of the Language Acquisition Device in L1 acquisition, worked in L2 acquisition (i.e., Mitchell & Myles 2004, White 2003).

An experiment on the processing of Chinese empty subject sentences is conducted. The participants are English native speakers studying Chinese. They are divided into beginner level, intermediate level, and advanced level. At the stage where the matrix verbs have not been acquired, answering of the questions is forced. General-purpose strategies have to be used in L1, since they have no other way, whereas in the parsing (sentence processing) of L2, the participants would employ linguistic strategies of their first language. For L2 (Chinese) learners (L1 English) of lower proficiency, parsing will receive strong influence from the first language. At a higher proficiency level, the same strategy used by Chinese native speakers will be used.

In the next section, I will clarify the following problems.

i) Are "Perceptual strategies" observed in participants who have higher cognitive ability?

ii) Does first language influence the parsing?

iii) Do participants of higher proficiency use the same strategies employed by Chinese native speakers?
4.2 Experiment

This section illustrates the methods used to study the parsing strategies employed by participants, so as to understand if L2 learners follow the DSFS hypothesis. The experimental design, expected results and result analysis will be discussed.

4.2.1 Experimental Design

Sentence stimuli are manipulated in terms of sentence structure and word selection, so that we can study the parsing strategies employed by participants of different L2 proficiency. This section will first explore the sentence stimuli manipulation. The experimental sentences are shown below. The words used in the experimental sentences were chosen from three Chinese textbooks\(^\text{11}\) written for foreign learners. The verbs were deliberately chosen from different levels, while all other words were chosen from a beginners’ textbook so we can differentiate participants with different proficiency. All participants, no matter which proficiency level they were at, should have known all words other than the matrix verbs.

\[(48)\]  
\(\text{SOV order, Subject control sentence}\)

\begin{tabular}{cccccc}
 P1 & P2 & P3 & P4 & P5 & P6 \\
\end{tabular}

\begin{tabular}{l}
比尔1 / 对安娜2 / 发誓说 / [一定 / 努力 / PRO1 学汉语]。 \\
Bill (male) to Anna (female) swear that certainly hard study Chinese
\end{tabular}

‘Bill swore to Anna that he would certainly study Chinese hard.’


b. **SOV order, Object control sentence**

比尔1 / 对 安娜2 / 赞咐 说 / [一定 / 努力 / PRO2 学 汉语]。

Bill (male) to Anna (female) persuade that certainly hard study Chinese

‘Bill persuaded Anna to study Chinese hard.’

[Question sentence] 安娜 一定 努力 学 汉语。

Anna  yiding  nuli  xue hanyu

‘Anna will certainly study Chinese hard.’

c. **OSV order, Subject control sentence**

对 安娜1 / 比尔1 / 发誓 说 / [一定 / 努力 / PRO1 学 汉语]。

To Anna (female) Bill (male) swear that certainly hard study Chinese

‘To Anna, Bill swore that he would certainly study Chinese hard.’

[Question sentence] 比尔 一定 努力 学 汉语。

Bill  yiding  nuli  xue hanyu

‘Bill will certainly study Chinese hard.’
d. **OSV order, Object control sentence**

对安娜 / 比尔 / 嘱咐说 / [一定 / 努力 / PRO2 学汉语]。

Dui AnNa / BiEr / zhufu shuo [yiding nuli PRO2 xue hanyu].

To Anna (female) Bill (male) persuade that certainly hard study Chinese

‘To Anna, Bill persuaded to study Chinese hard.’

[Question sentence]安娜 一定 努力 学汉语。

Anna yiding nuli xue hanyu

Anna certainly hard study Chinese

‘Anna will certainly study Chinese hard.’

The matrix verb *fashi* ‘swear’ in (48a, c) is a subject control verb, whereas the matrix verb *zhufu* ‘persuade’ in (48b, d) is an object control verb. (48a, b) took the ‘subject – object’ word order, and (48c, d) the ‘object – subject’ word order. Thus, the experiment design was 2 (verb types) \* 2 (word orders).

Twenty-eight pairs of experimental sentences like (48), each consisted of four conditions, were constructed, which made up a total of one hundred and twelve sentences. The Latin square method was adopted in this experiment. The one hundred and twelve experimental sentences were divided into four lists, such that only one condition from each pair was presented to each participant. Each list was composed of seventy sentences, including twenty-eight experimental sentences, twenty-eight filler sentences, six warm-up sentences and eight practice sentences (see Appendix E). These sentences were presented in a random order.

### 4.2.2 Apparatus and Procedure

Thirty participants participated in this experiment. All participants are English native
speakers who had studied Chinese in University of Southern California, Peking University, and Fudan University for at least half a year. All participants had normal or corrected eyesight.

The experiment was conducted with SuperLab 2.0 running on a CX835LS dynabook notebook computer. Each trial consisted of two parts, namely the self-paced reading task and the comprehension task. In the self-paced reading task, participants were asked to read sentences in a moving window. The sentence was chunked into phrases. One phrase was displayed at each time. Participants were instructed to press the 'Next' key immediately after they had finished reading the text on the screen. Once the key was pressed, the moving window would move rightward, so that the previous chunk would disappear from the screen and the next chunk would show up. All sentences ended with a full stop mark (。). The comprehension task would start once the full stop mark was read. A YES/NO question about the sentence, such as “Bill will certainly study Chinese hard.” for subject control sentences and “Anna will certainly study Chinese hard.” for object control sentences, would then be displayed in the middle of the screen. Participants were instructed to respond to the question using either the YES or NO key. All the question sentences are assumed to be “correct” if the corresponding control sentences are correctly interpreted. However, if the participants had not acquired the matrix verb, he (she) would not know the “correct” answer.

The number of YES responses and NO responses was calculated for each question sentence. As discussed in the previous Chapters, the response pattern of YES (judgment as correct in a correct sentence) and NO (judgment as wrong in a wrong sentence) is different. In the YES responses, only one correct positive evidence supports the YES answer, whereas it is necessary to check all the negative possibilities in the NO responses. Thus, NO responses will require more time and will be less accurate than the YES responses. Therefore, we assume that the YES responses support clearly what the participants selected, e.g., having answered the
question “Bill will certainly study Chinese hard.” as YES clearly supports Bill (henceforth “NP1”) preference. On the other hand, NO response means a kind of “rejection”. For example, a NO response to the question “Anna will certainly study Chinese hard.” indicates that the participants have rejected Anna (henceforth “NP2”) as a possible answer to the preceding empty subject sentence. This NP2-rejection leads to the two possible interpretations: NP1 (Bill) or a third party (other than NP1 and NP2). Since the rejection of NP2 includes NP1 interpretation, it might support NP1 preference indirectly and secondarily. That is, the YES responses to NP1/NP2 support NP1/NP2 preference directly, whereas NO responses to NP1/NP2 support NP2/NP1 preference indirectly and secondarily.

Following the on-line tasks, the participants were asked whether they knew the subject/object control verbs used in the experiments. Thirty participants were divided into three groups: beginner level (ten participants who hardly knew any of the matrix verbs), intermediate level (ten participants who knew about half of the matrix verbs), and advanced level (ten participants who knew most of the matrix verbs) (see Table 4-1). There were exactly ten participants in each group.

The average Chinese study time of participants at the beginner level is 180 hours (20 weeks × 6 times × 1.5 hours), 798 hours for participants at the intermediate level (76 weeks × 7 times × 1.5 hours), and 1020 hours for participants at the advanced level (136 weeks × 5 times × 1.5 hours).

Table 4-1 shows the results of the off-line experiment. In each list, there are seven subject control verbs and seven object control verbs. Since there are ten participants in this experiment, there were in total seventy subject control verbs (7 verbs × 10 participants) and seventy object control verbs (7 verbs × 10 participants).
Table 4-1: Number of acquired verbs (AV) and unacquired verbs (UV)

<table>
<thead>
<tr>
<th></th>
<th>Beginner level</th>
<th>Intermediate level</th>
<th>Advanced level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AV</td>
<td>UV</td>
<td>AV</td>
</tr>
<tr>
<td>Subject control verb</td>
<td>0</td>
<td>70</td>
<td>23</td>
</tr>
<tr>
<td>Object control verb</td>
<td>1</td>
<td>69</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>139</td>
<td>54</td>
</tr>
</tbody>
</table>

In the next part, the anticipated results from the SOV word order and OSV word order will be discussed separately, because the nearest filler to the empty subject differs in the SOV word order and the OSV word order.

4.2.3 **SOV word order**

4.2.3.1 *Prediction*

**Unacquired verbs**

As shown in Table 4-1, it is clear that the beginners hardly acquired any matrix verbs, so they are unable to make use of the control information provided. They, of course, could not determine whether a sentence is a subject control sentence or an object control sentence. However, they had to answer the questions. If they do not employ any strategies, and answered the questions randomly, the difference between the number of YES and NO responses to the question “Bill will certainly study Chinese hard.” would not be significant. The difference between the number of YES and NO responses to the question “Anna will certainly study Chinese hard.” would also be insignificant.
As discussed in Chapter 2 and Chapter 3, various possibilities are available with regard to the insignificant difference: the participants do not use any strategies completely, or some competing strategies are used randomly, strategies used may differ due to individual variations, or depending on the experimental sentences. Therefore, I will study the overall data, but not the data of individuals. If the result turns out to be insignificant, there are two possibilities: participants do not use any strategies completely, or some competing strategies are used randomly.

If they "guess" the sentence with some strategies, the guess could not be done using information of the matrix verbs, that is to say, the choice would be determined by the nouns.

i): Perceptual strategy – recency strategy

Because the participants of this experiment are adult English native speakers, their cognitive ability is expected to be higher than that of grade-schoolers, and they might also employ different comprehension strategies when they encountered unknown words. If "distance" information (a cognitive heuristic) is used by the participants (i.e., recency strategy), the nearest filler (Anna) would be preferred as the filler in the SOV word order. A higher number of YES responses for "Anna will certainly study Chinese hard." would be expected, which is a direct indication for the 'recent strategy'. As an indirect and secondary indication, NO responses for "Bill will certainly studies Chinese hard." would also be expected, because NP1 (Bill) is a distant filler from PRO.

ii): Perceptual strategy – primacy strategy

If "position" information (another cognitive heuristic) is used by the participants (i.e., primacy strategy), the filler at the beginning of the sentence (Bill) would be preferred as the
filler. Then, as a direct indication, a larger number of YES responses for “Bill will certainly studies Chinese hard.” would be expected. As an indirect and secondary indication, a larger number of NO responses for “Anna will certainly study Chinese hard.” would also be expected.

iii): Linguistic strategy – the verb shuo

Since participants had not acquired the matrix verbs, there is a high possibility of shuo being considered as the matrix verb (say) instead of a complementizer. According to the textbook for beginners, beginners should have learnt the verb shuo. Because the agent of the verb shuo is the subject, the subject of the complement sentence would be considered as the agent of shuo. Naturally, the empty subject of the complement sentence is to be understood as the subject of the matrix clause. In this case, as a direct indication for using the verb shuo, we expected the number of YES responses for “Bill will certainly studies Chinese hard.” to be higher. The indirect and secondary indication is that NO responses for “Anna will certainly study Chinese hard.” would increase. The former indicates NP1 preference, whereas the latter indicates NP2-rejection preference (indirect NP1 preference).

iv): Linguistic strategy – the preposition dui

There is another possibility that participants who had not acquired the matrix verbs might prefer to fill the empty subject with NP2 (Anna), because the preposition dui before NP2 makes NP2 prominent. We expect there to be more YES responses to the question “Anna will certainly study Chinese hard.” than the question “Bill will certainly studies Chinese hard.”, because the preposition dui appears before NP2. Furthermore, we also expect that there would be more NO responses to the question “Bill will certainly studies Chinese hard.” than the question “Anna will certainly study Chinese hard.”, since the preposition dui do not appear before NP1.
Summary

The recency strategy and primacy strategy are "Perceptual strategies", while the use of information from the verb *shuo* and the preposition *dui* are "Linguistic strategies". The predictions of unacquired verbs are shown below.

Table 4-2: Predictions of unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>no strategy employed</th>
<th>YES responses = NO responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>some strategies employed</td>
<td>perceptual strategies</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>linguistic strategies</td>
<td>primacy strategy</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the verb <em>shuo</em></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the preposition <em>dui</em></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Acquired verbs

The participants of the intermediate level should have acquired about half of the matrix verbs, and advanced participants should have acquired almost all control information of the experimental verbs. We assume that the correct answer rate would be higher for sentences containing an acquired verb. Naturally, participants are expected to utilize "Linguistic strategies" to process a sentence when they have acquired the matrix verbs. If the way they process sentences involving acquired verbs is the same as Chinese native speakers (using the
matrix verb immediately, see Chapter 1), we would expect that the processing of empty subject
will start when the matrix verb is input, and the processing would end when the verb of
complement clause verb is input. Therefore, significant difference should not be observed in the
reading times (RTs) of the complement sentence verb. If the assumption is right, the RTs of
subject control verbs should be shorter than that of object control verbs.

Table 4-3: Predictions of RTs and correct answers for acquired verbs in SOV order

<table>
<thead>
<tr>
<th>RTs of P3</th>
<th>(48a) &lt; (48b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTs of P6</td>
<td>(48a) = (48b)</td>
</tr>
<tr>
<td>Percentage of correct answers</td>
<td>high</td>
</tr>
</tbody>
</table>

Would the L2 learners of lower proficiency employ “Perceptual strategies” when
processing empty subject sentences including unacquired verbs? When the participants
processed Chinese empty subject sentences, would the same tendency to L1 be seen as the
difference level of verb acquisition? Next, I will report the results of the experiment for the
SOV word order.

4.2.3.2 Results and discussion

In this section, I will suggest how the strategy of parsing changes with the different levels
of acquisition of the matrix verbs in the SOV word order.

Unacquired verbs

Beginner level

The results of beginner level learners for the SOV word order are shown below.
Table 4-4: Questions and YES/NO responses by beginners on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Bill, subject, distant filler)</td>
<td></td>
<td>47 (67%)</td>
<td>23 (33%)</td>
<td>70</td>
</tr>
<tr>
<td>NP2 (Anna, object, recent filler, preposition dui)</td>
<td></td>
<td>38 (55%)</td>
<td>31 (45%)</td>
<td>69</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>85</td>
<td>54</td>
<td>139</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p = .1659$, n.s.)

There is no significant difference between the YES/NO responses and sentence question type (Fisher’s exact test, $n=139$, $p = .1659$), as shown in Table 4-4. From this result, it seems that beginners did not employ any strategies to “guess” the sentences. However, the beginners have higher cognitive ability than the elementary school children in the previous experiments, it is appropriate to think that the beginners did employ some strategies to “guess” the sentences.

The insignificance might have been due to the result of mutual competition between NP1 preference and NP2 preference strategies. For example, if beginners employ the recency strategy and primacy strategy randomly, the nearest filler NP2 should be preferred to fill the empty subject. At the same time, NP1 at the beginning of the sentence is also preferred to fill the empty subject. The competition between strategies led to an insignificant YES/NO response difference between NP1 and NP2. As for other possibilities, beginners might use the recency strategy and the verb shuo randomly, since NP2 is the nearest filler, while NP1 is the agent of the verb shuo. Moreover, beginners may use the preposition dui and primacy strategy randomly, since the preposition dui is before NP2, while NP1 is at the beginning of the sentence. Also, beginners might use the preposition dui and the verb shuo randomly, since the preposition dui appears before NP2, while NP1 is the agent of the verb shuo. The strategies employed in the
beginner level for the SOV word order are shown below.

(49) Strategies used at the beginner level for unacquired verbs in SOV order:

a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy

b. perceptual strategy: recency strategy + linguistic strategy: the verb *shuo*

c. linguistic strategy: the preposition *dui* + perceptual strategy: primacy strategy

d. linguistic strategy: the preposition *dui* + linguistic strategy: the verb *shuo*

Intermediate level

The results of intermediate level learners for the SOV word order are shown below.

Table 4-5: Questions and YES/NO responses by intermediate level learners on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (<em>Bill</em>, subject, distant filler)</td>
<td></td>
<td>28 (60%)</td>
<td>19 (40%)</td>
<td>47</td>
</tr>
<tr>
<td>NP2 (<em>Anna</em>, object, recent filler, preposition <em>dui</em>)</td>
<td></td>
<td>7 (18%)</td>
<td>32 (82%)</td>
<td>39</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>35</td>
<td>51</td>
<td>86</td>
</tr>
</tbody>
</table>

(Fisher's exact test: *p* < .01)

Table 4-5 shows a significant difference between responses given to subject control sentence questions and object control sentence questions (Fisher's exact test, *n*=86, *p*=.0001, *p*<.05). In contrast to the beginner level, intermediate level learners show a higher ratio of YES responses in subject control sentence questions (60%) than in object control sentence questions (18%). This is a direct indication for NP1 (*Bill*) preference.
Furthermore, the number of NO responses is significantly higher than that of YES responses for the object control sentence questions (YES 7 vs. NO 32). This result shows a strong tendency that intermediate participants rejected using NP2 (Anna, object, recent filler, preposition dui) to fill the empty subject.

From the above results, it seems that intermediate participants might prefer NP1 (Bill, subject, distant filler), the filler at the beginning of the sentence, or the agent of the verb shuo, to fill the empty subject. These strategies led to a strong NP1 preference. The strategies employed in the intermediate level for the SOV word order are shown below.

\[(50)\] Strategies used by intermediate level learners for unacquired verbs in SOV order:

a. perceptual strategy: primacy strategy

b. linguistic strategy: the verb shuo

Advanced level

The results of advanced level learners for the SOV word order are shown below.

Table 4-6: Questions and YES/NO responses by advanced level learners on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>YES responses</th>
<th>NO responses</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Bill, subject, distant filler)</td>
<td>19 (86%)</td>
<td>3 (14%)</td>
<td>22</td>
</tr>
<tr>
<td>NP2 (Anna, object, recent filler, preposition dui)</td>
<td>3 (27%)</td>
<td>8 (73%)</td>
<td>11</td>
</tr>
<tr>
<td>total</td>
<td>22</td>
<td>11</td>
<td>33</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: p<.01)
Table 4-6 shows a significant difference between responses given to subject control sentence questions and object control sentence questions (Fisher’s exact test, \( n=33, p=0.0013, p<0.05 \)). A higher ratio of YES responses is obtained for subject control sentence questions (86%) than object control sentence questions (27%). This is a direct indication for NP1 preference. In addition, the number of YES responses is significantly higher than that of NO responses in the subject control sentence questions (YES 19 vs. NO 3). This also supports NP1 preference strongly. Advanced participants seem to prefer NP1 as the empty subject as much as intermediate participants. From the results, advanced participants might prefer the filler at the beginning of the sentence (NP1) or the agent of the verb *shuo* (NP1) to fill the empty subject.

The strategies employed in the advanced level for the SOV word order are shown below.

(51) Strategies used by advanced level learners for unacquired verbs in SOV order:

a. perceptual strategy: primacy strategy

b. linguistic strategy: the verb *shuo*

Acquired verbs

In the intermediate level, half of the matrix verbs had been acquired. At the advanced level, participants had acquired almost all of the matrix verbs, and therefore they could judge the type of experimental sentences, and answer the questions correctly. Table 4-7 shows the percentage of correct answers in the SOV word order.
Table 4-7: Percentage of correct answers for acquired verbs in SOV order

<table>
<thead>
<tr>
<th></th>
<th>Beginner level</th>
<th>Intermediate level</th>
<th>Advanced level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject control sentence</td>
<td>15/23 = 65%</td>
<td>41/48 = 85%</td>
<td></td>
</tr>
<tr>
<td>Object control sentence</td>
<td>0/1 = 0%</td>
<td>19/31 = 61%</td>
<td>46/59 = 78%</td>
</tr>
<tr>
<td><em>t</em> test</td>
<td><em>t</em>(9) = 0.098, p = .924 n.s.</td>
<td><em>t</em>(9) = 1.587, p = .147 n.s.</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-7 is the percentage of correct answers for acquired verbs in the SOV word order. Here, I will not refer to the result of the beginners, because there is only one acquired verb. The higher percentage of correct answers in the advanced level shows that they are able to use the control information of the matrix verbs to judge the questions correctly. On the other hand, the lower percentage of correct answers in the intermediate level shows that they are still incapable of judging the sentences by using information of the verb correctly. Therefore, there is a possibility that intermediate participants did not know the matrix verbs well, though they claimed they had acquired the matrix verbs.

From Table 4-7, we know that advanced participants are able to judge the answers correctly. Next, I will present the results of the RTs of phrases to see whether participants who had acquired matrix verbs employ the same strategy as Chinese native speakers.
Figure 4-1 shows the RTs of each phrase in the SOV word order for acquired verbs at the intermediate level. In the RTs of the matrix verb P3, a significant difference is not observed (subject control sentence: $M = 1617 \text{ms}$; object control sentence: $M = 1715 \text{ms}$, $t(9) = .619$, $p = .552$). In the RTs of the complement clause verb P6, a significant difference is also not observed (subject control sentence: $M = 955 \text{ms}$; object control sentence: $M = 931 \text{ms}$, $t(9) = .342$, $p = .740$).

Unlike Chinese native speakers, there is no significant difference in the RTs between subject control verbs and object control verbs when the participants of intermediate level processed sentences containing an acquired verb. Therefore, this result does not support the "Linguistic strategy" that "the lexical information of a verb is used immediately". Even though there is no significant difference in the RTs of the complement sentence verbs (which is the result for Chinese native speakers), this result cannot be interpreted as an indication that empty subject processing ended when the complement clause verb is input, because the onset of
parsing is uncertain.

It has been observed that participants at the intermediate level have a lower correct answer rate, and their parsing strategies are different from those of Chinese native speakers when they processed sentences with an acquired verb. The strategies that are employed in sentences with an unacquired verb might also be used in sentences involving an acquired verb.

Figure 4-2: RTs of each phrase for acquired verbs in SOV order at advanced level

Figure 4-2 shows the RTs of each phrase in the SOV word order for acquired verbs at the advanced level. The RTs of the matrix verb P3 is longer for the object control verbs than the subject control verbs, and a significant difference is observed (subject control sentence: $M = 1564\text{ms}$; object control sentence: $M = 1842\text{ms}$, $t_{(9)} = 3.782, p < .05$). On the other hand, in the RTs of the complement clause verb P6, a significant difference is not observed (subject control sentence: $M = 1154\text{ms}$, object control sentence: $M = 1187\text{ms}$, $t_{(9)} = .362, p = .726$).

The RTs of the object control verbs is longer than that of the subject control verbs. Also, there is no significant difference in the RTs of complement sentence verbs. It can be said from
these results that the same parsing tendency as a Chinese native speaker exists in these advanced L2 learners. Empty subject processing start when the matrix verb is input, and processing ended when the complement clause verb is input. Therefore, I claim that advanced level participants used the control information of the matrix verbs immediately.

Table 4-8: Strategies used by intermediate and advanced level learners for acquired verbs in SOV order

<table>
<thead>
<tr>
<th>Intermediate level</th>
<th>i) perceptual strategy: primacy strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii) linguistic strategy: the verb shuo</td>
</tr>
<tr>
<td>Advanced level</td>
<td>linguistic strategy: immediate use of the control information of the verb</td>
</tr>
</tbody>
</table>

In conclusion, in the SOV word order, beginners use general strategies such as the 'recency strategy' and 'primacy strategy', or linguistic strategies such as 'the verb shuo', and 'the preposition dui' to "guess" the sentences, and shift to general strategies such as the 'primacy strategy' or linguistic strategies such as 'the verb shuo' at the intermediate level, followed by shifting to linguistic strategies that use the control information on verb immediately at the advanced level.

From these results on the SOV order, we cannot tell which of the general strategies ('recency strategy' or 'primacy strategy') or linguistic strategies ('the verb shuo' or 'the preposition dui') are used by beginner level participants. Therefore, the reversed order (OSV word order) version of the experiment is conducted to see which of these strategies are used.
4.2.4  *OSV word order*

In the OSV word order, NP1 (*Bill*) and NP2 (*Anna*) are swapped. Different from the SOV word order, NP1 (*Bill*) become the nearest filler to PRO, and NP2 (*Anna*) become the initial filler. Would the difference in word order lead to different results?

4.2.4.1  *Prediction*

**Unacquired verbs**

As discussed above, if participants process the sentences including an unacquired verb randomly, a significant difference between the YES/NO responses for the subject and object control sentence questions would not be expected. Also, the insignificant difference between the YES/NO responses may be attributed to the competing strategies. If they employ some strategies to "guess" the sentence, then the information of the nouns would be used, since they had not acquired the matrix verbs.

i): Perceptual strategy – recency strategy

If participants use the 'recency strategy' to process the empty subject of a complement clause, NP1 (*Bill*) would become the filler as it is nearer to the empty subject, contrary to the SOV word order. In this case, the YES responses for "*Bill will certainly study Chinese hard.*" would increase. Furthermore, an indirect and secondary effect is that NO responses for "*Anna will certainly studies Chinese hard.*" would increase, because NP2 (*Anna*) is a distant filler from PRO in the OSV word order.

ii): Perceptual strategy – primacy strategy

If participants use the 'primacy strategy' to process the empty subject of a complement
clause, NP2 (Anna) at the beginning of the sentence would be preferred to fill the empty subject, contrary to the SOV word order. In this case, as a direct indication, the YES responses for “Anna will certainly studies Chinese hard.” would increase. As an indirect and secondary indication, the NO responses for “Bill will certainly studies Chinese hard.” would increase.

iii): Linguistic strategy – the verb shuo

Since the verb shuo appeared in the textbook for beginners, I assum participants had already acquired this verb. If this is the case, the possibility of using the lexical information of the verb shuo would be high. Since the agent of the verb shuo is the subject of the matrix clause, the empty subject of the complement sentence is to be understood as the subject of the matrix clause. In this case, the YES responses for “Bill will certainly studies Chinese hard.” would increase. As an indirect and secondary indication, the NO responses for “Anna will certainly studies Chinese hard.” would increase.

iv): Linguistic strategy – the preposition dui

If the preposition dui is prominent to the L2 learners, then NP2 would be preferred to fill the empty subject, since the preposition dui is in front of NP2. Therefore, as a direct indication, a higher YES responses for the object control sentence questions would be expected. As an indirect and secondary indication, the NO responses for the subject control sentence questions would also increase.

Summary

The recency strategy and primary strategy are “Perceptual strategies”, while the use of information from the verb shuo, and the preposition dui are “Linguistic strategies”. The
predictions of unacquired verbs in the OSV word order are shown below. Since subject and object are swapped in the OSV word order, predictions on the ‘recency strategy’ and ‘primacy strategy’ are assumed to be different from those of the SOV word order.

Table 4-9: Predictions of unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>no strategy employed</th>
<th>YES responses = NO responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>some strategies</td>
<td></td>
</tr>
<tr>
<td>employed perceptual</td>
<td></td>
</tr>
<tr>
<td>strategies</td>
<td></td>
</tr>
<tr>
<td>recency strategy</td>
<td>YES NP1 (Bill) &gt; YES NP2 (Anna)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Bill) &lt; NO NP2 (Anna)</td>
</tr>
<tr>
<td>primacy strategy</td>
<td>YES NP1 (Bill) &lt; YES NP2 (Anna)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Bill) &gt; NO NP2 (Anna)</td>
</tr>
<tr>
<td>linguistic strategies</td>
<td></td>
</tr>
<tr>
<td>the verb shuo</td>
<td>YES NP1 (Bill) &gt; YES NP2 (Anna)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Bill) &lt; NO NP2 (Anna)</td>
</tr>
<tr>
<td>the preposition dui</td>
<td>YES NP1 (Bill) &lt; YES NP2 (Anna)</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Bill) &gt; NO NP2 (Anna)</td>
</tr>
</tbody>
</table>

Acquired verbs

The prediction is the same as the SOV word order, in which the correct answer rate will be higher for sentences which included acquired verbs, and the way participants process the sentence involving acquired verbs is expected to be as sophisticated as Chinese native speakers. The processing of empty subject would start when the matrix verb is input, and the processing would end when the complement clause verb is input. Therefore, a significant difference should not be observed in the RTs of the complement sentence verb. On the other hand, when the matrix verb is input, the RTs of the subject control verb are expected to be shorter than that of
the object control verb.

Table 4-10: Predictions of RTs and correct answers for acquired verbs in OSV order

<table>
<thead>
<tr>
<th>RTs of P3</th>
<th>(48c) &lt; (48d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTs of P6</td>
<td>(48c) = (48d)</td>
</tr>
<tr>
<td>Percentage of correct answers</td>
<td>high</td>
</tr>
</tbody>
</table>

Can the results from the OSV word order give insights to the problems of “Perceptual strategies” and “Linguistic strategies”, which is inseparable in the SOV word order? In the following, I will introduce the results of the OSV word order.

4.2.4.2 Results and discussion

Beginner level

The results of beginner level in the OSV word order are shown below.

Table 4-11: Questions and YES/NO responses by beginners on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>response subject NP of question sentence</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Bill, subject, recent filler)</td>
<td>49 (70%)</td>
<td>21 (30%)</td>
<td>70</td>
</tr>
<tr>
<td>NP2 (Anna, object, distant filler, preposition du)</td>
<td>48 (70%)</td>
<td>21 (30%)</td>
<td>69</td>
</tr>
<tr>
<td>total</td>
<td>97</td>
<td>42</td>
<td>139</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: \( p = .9999, \text{n.s.} \))
From Table 4-11, there is no significant difference between the YES/NO responses and sentence question type (Fisher's exact test, \( n=139, p=0.9999 \)). As discussed above, since beginners have higher cognitive ability than the elementary school children in the previous experiments, it is appropriate to think that beginners did employ some strategies to "guess" the sentences.

It seems that the insignificant difference between NP1 and NP2 is due to the presence of two competing strategies. The factors which might have strengthened NP1 preference are hypothesized to be the 'recency strategy' or 'the verb shuo', while factors that enhanced NP2 preference are thought to be the 'primacy strategy' or 'the preposition dui'. Because these strategies are used in a mixed way, a significant difference is not observed between NP1 preference and NP2 preference. The strategies employed in the beginner level for the OSV word order are shown below.

\[(52)\] Strategies used by beginner for unacquired verbs in OSV order:

- a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy
- b. perceptual strategy: primacy strategy + linguistic strategy: the verb shuo
- c. linguistic strategy: the preposition dui + perceptual strategy: recency strategy
- d. linguistic strategy: the preposition dui + linguistic strategy: the verb shuo

**Intermediate level**

The results of intermediate level learners for the OSV word order are shown below.
Table 4-12: Questions and YES/NO responses by intermediate level learners on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Bill, subject, recent filler)</td>
<td>49 (70%)</td>
<td>21 (30%)</td>
<td>70</td>
</tr>
<tr>
<td>NP2 (Anna, object, distant filler, preposition dui)</td>
<td>48 (70%)</td>
<td>21 (30%)</td>
<td>69</td>
</tr>
<tr>
<td>total</td>
<td>97</td>
<td>42</td>
<td>139</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p=0.9999$, n.s.)

From Table 4-12, there is no difference between the responses for the sentence question types (Fisher’s exact test, $n=86$, $p=0.9999$). At first glance, the intermediate level participants did not employ any strategies to “guess” the sentences containing unacquired verbs, since the number of YES/NO responses is almost the same. However, as the results of the SOV word order showed that they employed some strategies to “guess” the sentence, the insignificant difference in the OSV word order is probably due to the strategies, which make the difference between YES/NO responses insignificant. The ‘recency strategy’ or ‘the verb shuo’ enhanced NP1 preference, whereas the ‘primacy strategy’ or ‘the preposition dui’ enhanced NP2 preference. The strategies employed in the intermediate level for the OSV word order are shown below.

(53) Strategies used by intermediate level learners for unacquired verbs in OSV order:

a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy

b. perceptual strategy: primacy strategy + linguistic strategy: the verb shuo

c. linguistic strategy: the preposition dui + perceptual strategy: recency strategy

d. linguistic strategy: the preposition dui + linguistic strategy: the verb shuo
Advanced level

The results of advanced level learners for the OSV word order are shown below.

Table 4-13: Questions and YES/NO responses by advanced level learners on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>subject NP of question sentence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NP1 (Bill, subject, recent filler)</td>
<td>16 (73%)</td>
<td>6 (27%)</td>
<td>22</td>
</tr>
<tr>
<td>NP2 (Anna, object, distant filler, preposition dui)</td>
<td>4 (36%)</td>
<td>7 (64%)</td>
<td>11</td>
</tr>
<tr>
<td>total</td>
<td>20</td>
<td>13</td>
<td>33</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: .05<p<.10)

Table 4-13 shows that there is a significant tendency between responses given to subject control sentence questions and object control sentence questions (Fisher’s exact test, n=33, p=0.0645). Although preferential bias for NP1 (Bill) is observed, the difference only have a significant tendency, and do not reach a significant difference. From this result, it seems that advanced level participants did not employ any strategies to “guess” the sentences including the unacquired verbs. However, as the results of the SOV word order showed that they employed some strategies to “guess” the sentence, the insignificant difference in the OSV word order is probably due to the strategies, which made the difference between YES/NO responses insignificant. The ‘recency strategy’ or ‘the verb shuo’ enhanced NP1 preference, whereas the ‘primacy strategy’ or ‘the preposition dui’ enhanced NP2 preference. The strategies employed in the advanced level for the OSV word order are shown below.
Strategies used by advanced level learners for unacquired verbs in OSV order:

a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy
b. perceptual strategy: primacy strategy + linguistic strategy: the verb *shuo*
c. linguistic strategy: the preposition *dui* + perceptual strategy: recency strategy
d. linguistic strategy: the preposition *dui* + linguistic strategy: the verb *shuo*

Acquired verbs

As discussed above, at the intermediate level, more than half of the total matrix verbs had been acquired, while at the advanced level, participants had acquired almost all of the matrix verbs. The advanced learners are expected to judge the type of experimental sentences, and answer the questions correctly. Table 4-14 shows the percentage of correct answers in the OSV word order.

Table 4-14: Percentage of correct answers for acquired verbs in OSV order

<table>
<thead>
<tr>
<th></th>
<th>Beginner level</th>
<th>Intermediate level</th>
<th>Advanced level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject control sentence</td>
<td>13/23 = 57%</td>
<td>38/48 = 79%</td>
<td></td>
</tr>
<tr>
<td>Object control sentence</td>
<td>0/1 = 0%</td>
<td>17/31 = 55%</td>
<td>41/59 = 69%</td>
</tr>
<tr>
<td>( t ) test</td>
<td></td>
<td>( t(9) = .706, )</td>
<td>( t(9) = .73, )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( p = .498 ) n.s.</td>
<td>( p = .484 ) n.s.</td>
</tr>
</tbody>
</table>

Table 4-14 shows the percentage of correct answers for acquired verbs in the OSV word order. Since the beginners knew only one verb, I will not refer to the result of the beginners. At the intermediate level, the difference between subject control sentences and object control sentences is not significant (57% vs. 55%). At the advanced level, the correct answer rate of
subject control sentences is slightly higher than that of object control sentences, but it is not significant (79% vs. 69%).

The percentage for the acquired verbs at the intermediate level was not high. Therefore, this result also does not show that they use the lexical information of the matrix verbs to process the empty subject sentences. When they processed sentences with acquired verbs, the acquired verbs are processed as if they are “guessing” the sentence.

The percentage of correct answers in subject and object control sentences are lower than those for the SOV word order, but higher than those of intermediate level learners. This result supports the view that the advanced level participants are able to use the matrix verbs correctly.

Next, I will discuss whether the RTs of each phrase showed the same tendency as Chinese native speakers. The RTs of each phrase at the intermediate level are shown below.

![Figure 4-3: RTs of each phrase for acquired verbs in OSV order at intermediate level](image)

Figure 4-3 shows the RTs of each phrase in the OSV word order for acquired verbs at the intermediate level. In the RTs of the matrix verb P3, a significant difference is not observed.
(subject control sentence: \( M = 1530 \text{ms} \); object control sentence: \( M = 1569 \text{ms} \), \( t(9) = .294, p = .775 \)). In the RTs of the complement clause verb P6, a significant difference is also not observed (subject control sentence: \( M = 1161 \text{ms} \); object control sentence: \( M = 1089 \text{ms} \), \( t(9) = .889, p = .397 \)).

The insignificant difference between the RTs of P3 and P6, similar to the SOV word order, suggests that the parsing strategies of intermediate level learners are different from those of Chinese native speakers.

The RTs of each phrase at the advanced level are shown below.

![Figure 4-4: RTs of each phrase for acquired verbs in OSV order at advanced level](image)

Figure 4-4 shows the RTs of each phrase in the OSV word order for acquired verbs by advanced level participants. The RTs of the matrix verb P3 are longer for the object control verbs than the subject control verbs. However, a significant difference is not observed (subject control sentence: \( M = 1294 \text{ms} \); object control sentence: \( M = 1426 \text{ms} \), \( t(9) = 1.349, p = .21 \text{ n.s.} \)).
In the RTs of the complement clause verb P6, a significant difference is also not observed (subject control sentence: $M = 1029\text{ms}$, object control sentence: $M = 1048\text{ms}$, $t(9) = .892$, $p = .396$).

The RTs of P3 in the SOV word order are shorter than those in the SOV word order (SOV-S-con 1564ms vs. OSV-S-con 1294ms, SOV-O-con 1842ms vs. OSV-O-con 1426ms). A significant difference is observed both in the word order ($F(1,9) = 5.674$, $p < .05$), and in the sentence type ($F(1,9) = 8.787$, $p < .05$). It is possible that in the OSV word order, the subject became nearer to the matrix verb, while the object was moved (by Dui-construction) to the beginning of the sentence. These factors might facilitate the participants to recall these elements easily when the matrix verb is input. As a result, the RTs in the OSV word order became shorter than those in the SOV word order.

In the RTs of P6, the difference between subject control verb and object control verb is not significant. This result is the same as that of Chinese native speakers, in which the processing of empty subjects in the complement clause had ended when the complement clause verb is input.

From the above results, I claim that advanced level participants used the control information of the matrix verbs immediately.
Table 4-15: Strategies used by intermediate and advanced level learners for acquired verbs in OSV order

<table>
<thead>
<tr>
<th></th>
<th>Intermediate level</th>
<th>Advanced level</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) perceptual</td>
<td>perceptual strategy: recency strategy + perceptual strategy: primacy strategy</td>
<td>linguistic strategy: immediate use of the control information of the verb</td>
</tr>
<tr>
<td>ii) perceptual</td>
<td>perceptual strategy: primacy strategy + linguistic strategy: the verb <em>shuo</em></td>
<td></td>
</tr>
<tr>
<td>iii) linguistic</td>
<td>linguistic strategy: the preposition <em>dui</em> + perceptual strategy: recency strategy</td>
<td></td>
</tr>
<tr>
<td>iv) linguistic</td>
<td>linguistic strategy: the preposition <em>dui</em> + linguistic strategy: the verb <em>shuo</em></td>
<td></td>
</tr>
</tbody>
</table>

In the OSV word order, it seems that the same combination of strategies, which included the ‘recency strategy’, ‘primacy strategy’, ‘the verb *shuo*’ and ‘the preposition *dui*’, is used randomly at the beginner and advanced levels when “guessing” sentences containing an unacquired verb. The intermediate level participants processed sentences, regardless of their knowledge of the matrix verb, using the ‘recency strategy’, ‘primacy strategy’, ‘the verb *shuo*’ and ‘the preposition *dui*’. Participants at the advanced level used the same strategies as that for intermediate level participants when they “guess” the sentences including the unacquired verbs, and used control information of the matrix verbs immediately when they process the sentences including the acquired verbs.

The results of the OSV word order did not seem to solve the problem that was not solved in the SOV word order. That is, which of the following, “Perceptual strategies” (i.e., ‘recency strategy’, ‘primacy strategy’) or “Linguistic strategies” (i.e., ‘the verb *shuo*’, ‘the preposition *dui*’), was used at the beginner level? I will discuss this problem in the next section.
4.2.5  General discussion from SOV and OSV orders

Beginner level

It would be interesting to know how an L2 beginner, who has a native speaker's cognitive ability but low language proficiency, processes empty subject sentences. Would it be the same as or different from how grade-schoolers would do?

Competition between NP1 preference and NP2 preference was observed both in the SOV word order and OSV word order ((49), (52)). That a combination of the 'recency strategy + primacy strategy' or 'the preposition dui + the verb shuo' were employed at the same time could account for these results. However, the problem is, whether two "Linguistic strategies" (i.e., 'the preposition dui + the verb shuo') can be used at the same time at the beginner level. There is a possibility that the learner at the beginner level had not acquired preposition dui completely yet. I will return to this problem later. The strategies used by beginners in the SOV and OSV word orders are shown below.

Table 4-16: Summary of strategies by beginners for SOV and OSV orders

<table>
<thead>
<tr>
<th>Beginner level</th>
<th>i) perceptual strategy: recency strategy + perceptual strategy: primacy strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii) linguistic strategy: the preposition dui + linguistic strategy: the verb shuo</td>
</tr>
</tbody>
</table>

Intermediate level

From the YES/NO responses in the OSV word order, it seems that the participants at the intermediate level did not employ any strategies to "guess" the sentences (Table 4-12). However, a clear difference between the YES/NO responses was seen in the SOV word order object control sentence questions (Table 4-5). Therefore, I conclude that the intermediate level learners
would employ some strategies to “guess” the sentences with unacquired verbs.

The higher ratio of YES responses for NP1 was shown in the SOV word order (Table 4-5), whereas there is competition between NP1 preference and NP2 preference in the OSV word order (Table 4-12). The using of both parsing strategies, the ‘primacy strategy’ and ‘the verb shuo’, explains the above results. In the SOV word order, the ‘primacy strategy’ and ‘the verb shuo’ enhanced NP1 preference, while the ‘primacy strategy’ enhanced NP2 preference, and ‘the verb shuo’ enhanced NP1 preference in the OSV word order. This is consistent with the facts that, NP1 preference was observed in the SOV word order, whereas the difference between NP1 preference and NP2 preference was not significant in the OSV word order.

When the intermediate learners processed sentences involving an acquired verb, a lower percentage of correct answers were shown both in the SOV word order and OSV word order. Therefore, it seems that the intermediate learners processed the sentences with acquired verbs just like they had not acquired these verbs, although they claimed they “knew” the verbs. The strategies used by intermediate level learners in the SOV and OSV word orders are shown below.

Table 4-17: Summary of strategies by intermediate level learners for SOV and OSV orders

| Intermediate level | i) perceptual strategy: primacy strategy  
|                   | ii) linguistic strategy: the verb shuo |

Now, I will discuss the problem remained for the beginners: whether beginners can use two “Linguistic strategies” to “guess” the sentences. From our discussion on intermediate level learners, it was clearly shown that ‘the preposition dui’ was not employed at this level. If ‘the
preposition 'dui' was used at the beginner level, it is only appropriate to expect its use too at the intermediate level. The results showed that the preposition 'dui' was not understood by the beginners and intermediate learners.

Moreover, from Table 4-16, the two possibilities, i) and ii), were quite opposite. i) is the combination of two "Perceptual strategies", whereas ii) is the combination of two "Linguistic strategies". It is unnatural and impossible to use such opposing strategies at the same time. Therefore, I claim that beginners used the 'recency strategy' and 'primacy strategy' randomly.

Table 4-18: Summary of strategies by beginners for SOV and OSV orders (final)

<table>
<thead>
<tr>
<th>Beginner level</th>
<th>i) perceptual strategy: recency strategy + perceptual strategy: primacy strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii) linguistic strategy: the preposition 'dui' + linguistic strategy: the verb 'shuo'</td>
</tr>
</tbody>
</table>

Advanced level

From Table 4-6 and Table 4-13, the significant difference between the YES/NO responses show that advanced level learners employed some strategies to "guess" the sentences containing unacquired verbs. The tables also showed a higher ratio of YES responses for NP1 in the SOV word order and a significant tendency in OSV word order. From the results of SOV word order and OSV word order, I claim that the advanced level learners employed the 'primacy strategy' or 'the verb shuo' to "guess" the sentences containing unacquired verbs. This result is the same as that for the intermediate level learners.

When the advanced level participants read the sentences with acquired verbs, Figure 4-2 shows that the RTs of the matrix object control verb was significantly longer than the matrix subject control verb in the SOV word order. On the other hand, Figure 4-4 shows that the RTs
of the matrix object control verb was longer than the matrix subject control verb, but the
difference was not significant. This result was not identical to the result of Chinese native
speakers (the RTs of matrix object control verb was significantly longer than the matrix subject
control verb). As discussed above, it is possible that in the OSV word order, the subject became
nearer to the matrix verb, while the object was moved (by *dui*-construction) to the beginning of
the sentence. These factors might facilitate the participants to recall these elements easily when
the matrix verb was input. As such, the RTs became shorter than that of the SOV word order,
but the difference was not significant. Putting the result from the SOV and OSV word orders
together, the advanced level participants processed something at the stage of the matrix verbs,
because no significant difference was observed in the complement verbs.

Moreover, the percentage of correct responses was high as compared to the intermediate
group. These results indicate that verb control information becomes available at a later stage of
language learning. So, we can conclude that L2 learners made use of linguistic strategies based
on verb control information at a later stage of learning. The strategies used by the advanced
level learners in the SOV and OSV word orders are shown below.

Table 4-19: Summary of strategies by advanced level learners for SOV and OSV orders

<table>
<thead>
<tr>
<th>Advanced level verbs</th>
<th>i) perceptual strategy: primacy strategy</th>
<th>ii) linguistic strategy: the verb <em>shuo</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>acquired verbs</td>
<td>linguistic strategy: immediate use of the control information of the verb</td>
<td></td>
</tr>
</tbody>
</table>

The results of Chinese empty subject sentence processing by L2 learners suggest that
"Perceptual strategies" (i.e., 'recency strategy', 'primacy strategy') were used by lower
proficiency learners who had not acquired the matrix verbs, while the control information of the matrix verbs was used by advanced learners who had acquired the matrix verbs.

4.3 Concluding remarks

From the results of the SOV word order and OSV word order, it is clear that beginners who had not acquired the meaning of matrix verbs preferred using the 'recency strategy' and 'primacy strategy' to fill the empty subject. That is, non-linguistic and general-purpose strategies were utilized at the earlier stage of language acquisition.

At the intermediate level, the lower percentage of correct answers indicated that they processed the sentences including acquired verbs in the same manner as unacquired verbs. At this stage, “Perceptual strategy” (i.e., 'primacy strategy') and “Linguistic strategy” (i.e., 'the verb shuo') became prominent.

At the advanced level, the parsing strategy is the same as the intermediate level: the 'primacy strategy' or 'the verb shuo' was employed when they "guess" sentences containing unacquired verbs. On the other hand, the same parsing strategies as Chinese native speakers were used when the advanced learners processed the sentences including acquired verbs.

The parsing strategies used at different verb acquisition levels are shown below.
Now, I will answer the questions set forth at the beginning of this chapter.

i) Are “Perceptual strategies” observed in participants who have higher cognitive ability?

From Graph 4-1, “Perceptual strategies” were observed in lower proficiency participants, despite their higher cognitive ability. That is, “Perceptual strategies” are used not only when cognitive ability is low. When linguistic knowledge is insufficient, “Perceptual strategies” will be observed.

The shift of parsing strategies showed the same tendency as Chinese and Japanese grade-schoolers, in which the recency strategy is used earlier than the primacy strategy. That is, even in participants with higher cognitive ability, the primacy strategy will come after the recency strategy. Therefore, the recency strategy is easier as compared to the primacy strategy. Because the recency strategy is unrelated to memory capacity, but the primacy strategy is, the parser has to remember the beginning elements and process the following parts of a sentence, and this causes the parsing load to increase. Therefore, the parser will select an easier strategy to
“guess” the sentences at an earlier stage.

ii) Does first language influence parsing?

In this chapter, the influence of first language was not observed. I will continue to discuss this problem in the next chapter (L1 English, L2 Japanese).

iii) Do participants of higher proficiency use the same strategies employed by Chinese native speakers?

As discussed above, the participants of higher proficiency showed the same tendency as Chinese native speakers in parsing.

In conclusion, English native speakers learning Chinese would make use of a general-purpose strategy, such as the distance/position information (i.e., ‘primacy strategy’, ‘recency strategy’), at the earlier stages of L2 learning, and would utilize a combination of general-purpose strategy (i.e., ‘primacy strategy’) and linguistic strategy (i.e., ‘the verb shuo’) at the intermediate stage of L2 learning. At a later stage of L2 learning, linguistic strategy based on verb information (i.e., the control information of matrix verb) is used. It was also observed in L2 learning that the parsing strategies shift from non-linguistic to linguistic ones as linguistic knowledge grows. These results are clear evidence that support the DSPS hypothesis.

The lexical information of the verb is important for the identification of the empty subject. In English and Chinese, the matrix verb appears ahead of the empty subject. Chinese learners with English as L1 need not reset parameters to process the empty subject sentences. However, in Japanese, the matrix verb appears at the end of the sentence. Thus, Japanese learners with English as L1 have to reset parameters to process the empty subject sentences. Would the DSPS
hypothesis be observed among English native speakers studying Japanese? Which parameters, if any, would be reset? These are very interesting problems. In the next chapter, I will discuss them in detail.
Chapter 5: Processing empty subject sentences among L1 English / L2 Japanese learners

In Chapter 4, I discussed the “Developmental Shift of Parsing Strategies (DSPS)” hypothesis concerning English native speakers who are learning Chinese as a second language. The results suggest that non-linguistic strategies or general-purpose strategies are utilized at an early stage of language development, and these shift to linguistic strategies at the later stage of language learning. Interestingly, in the intermediate stage of learning, the learners tend to use both perceptual and linguistic strategies. This process of strategy shift might be due to the similarity of the two languages. As discussed in Chapter 1, the matrix verb, which is essential in identifying the empty subject, appears ahead of the empty subject in both English and Chinese. Therefore, English native speakers need not reset parameters to process Chinese empty subject sentences. However, this is different in Japanese, as the matrix verb appears at the end of the sentence. Therefore, English native speakers might have to reset parameters to process Japanese empty subject sentences.

Moreover, Chinese and English noun phrases have no case-marker that signifies their grammatical relations with the verb. Due to the lack of case information, English native learners of Chinese may use “Perceptual strategies” based on distance/position information to process Chinese empty subject sentences at the stage when the matrix verb has not been acquired. In contrast, Japanese is a language which uses case-marking particles. Case particles are added to the end of noun phrases. Therefore, even at the stage where the matrix verb has not yet been acquired, it is possible for L2 learners of Japanese to make use of such information provided by the case-marking particles (linguistic knowledge). Therefore, it is interesting to test whether the DSPS hypothesis applies to the processing of Japanese empty subject sentences by English...
In this chapter, I will present an experiment done on English native L2 learners of Japanese, which aimed at testing the parsing mechanism of Japanese empty subject sentences in L2 learners at different stages of language learning. Section 5.1 presents the results of a Japanese empty subject sentence experiment with both canonical and reverse word order by the L2 learners. Section 5.2 concludes the chapter by highlighting the implications of the reported difference across different level-groups, and clarifies whether or not the DSPS hypothesis applies to L2 learners of Japanese.

5.1 Experiment

In this section, I want to clarify the following problems that have been enumerated in Chapter 4.

i) Are "Perceptual strategies" observed in participants who have higher cognitive ability?

ii) How does one's first language influence parsing?

iii) Do participants of higher proficiency use the same strategy employed by Japanese native speakers?

5.1.1 Experimental Design

The experimental sentences are the same as those used in the elementary school experiments (Chapter 3, see Appendix D). The experimental sentences are shown below. Japanese script with Hiragana, Katakana and Kanji were used in the actual experiment. The matrix verb ibatta 'boast' in (55a, c) is a subject control verb, while the matrix verb susumeta 'persuade' in (55b, d) is an object control verb. (55a, b) took the 'subject – object' word order,
and (55c, d) took the ‘object – subject’ word order. Thus, the experiment design was 2 (verb types) × 2 (word orders).

(55) a. **SOV order, Subject control sentence**

<table>
<thead>
<tr>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
</tr>
</thead>
<tbody>
<tr>
<td>けんじくん1がきのうにまりさん2に/PRO1パソコンをかうことをいばった。</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

‘Yesterday, Kenji boasted to Mari that he would buy a personal computer.’

[Question sentence] けんじくんがパソコンをかいます。

Kenji-kun-ga pasokon-o kaimasu

‘Kenji will buy a personal computer.’

b. **SOV order, Object control sentence**

けんじくん1がきのうにまりさん2に/PRO2パソコンをかうことをすすめた。


‘Yesterday, Kenji persuaded Mari to buy a personal computer.’

[Question sentence] まりさんがパソコンをかいます。

Mari-san-ga pasokon-o kaimasu

‘Mari will buy a personal computer.’
c. **OSV order, Subject control sentence**


Mari-DAT yesterday Kenji-NOM computer-ACC buy fact-ACC boasted

‘Yesterday, Kenji boasted to Mari that he would buy a personal computer.’

[Question sentence] Kenji-kun-ga pasokon-o kaimasu

Kenji-NOM computer-ACC buy

‘Kenji will buy a personal computer.’

d. **OSV order, Object control sentence**


Mari-DAT yesterday Kenji-NOM computer-ACC buy fact-ACC persuaded

‘Yesterday, Kenji persuaded Mari to buy a personal computer.’

[Question sentence] Mari-san-ga pasokon-o kaimasu

Mari-NOM computer-ACC buy

‘Mari will buy a personal computer.’

Twenty pairs of experimental sentences like those in (55) were used, which consisted of four conditions (SOV order – OSV order; subject control - object control), and make up a total of eighty sentences. The Latin square method was adopted in this experiment. The eighty experimental sentences were divided into four lists. This was to ensure that only one condition from each pair was presented to each participant. Each list was composed of fifty-two sentences,
including twenty experimental sentences, twenty filler sentences, six practice sentences and six warm-up sentences (see Appendix D). These sentences were presented in a random order.

5.1.2 Apparatus and Procedure

Thirty participants, who were all English native speakers, participated in this experiment. They had been learning Japanese in Kyushu University for at least half a year. All participants had normal or corrected eyesight.

The experiment was conducted with LinguaLab running on a CX/335LS dynabook notebook computer. Each trial consisted of two parts, namely the self-paced reading task and the comprehension task. In the self-paced reading task, participants were asked to read sentences in a moving window. The sentence was chunked into phrases. One phrase was displayed at each time. Participants were instructed to press the “Space” key on a standard keyboard at the beginning of each trial. A ‘★’ sign would appear which signals the beginning of a sentence. Participants were told to press the same space key immediately after they have finished reading the text on the screen. Once the key was pressed, the moving window would move rightward, so that the previous chunk would disappear from the screen and the next chunk would show up. All sentences ended with a full stop mark (。). The comprehension task was to start once the full stop mark was read. A YES/NO question about the control sentence, such as “Kenji will buy a personal computer.” for a subject control sentence and “Mari will buy a personal computer.” for an object control sentence, would be displayed in the middle of the screen. Participants were instructed to respond to the question using either the YES or NO key. All the question sentences are assumed to be “correct” if the corresponding control sentences are correctly interpreted. However, if the participants had not acquired the matrix verb, he (she) would not know the “correct” answer.
The number of YES responses and NO responses was calculated for each question sentence. As discussed in the previous Chapters, the response pattern of YES (judgment as correct in a correct sentence) and NO (judgment as wrong in a wrong sentence) is different. In the YES responses, only one correct positive evidence supports the YES answer, whereas it is necessary to check all the negative possibilities in the NO responses. Thus, NO responses will require more time and will be less accurate than the YES responses. Therefore, we assume that the YES responses support clearly what the participants selected, e.g., having answered the question “Kenji will buy a personal computer.” as YES clearly supports Kenji-kun (henceforth “NP1”) preference. On the other hand, NO response means a kind of “rejection”. For example, a NO response to the question “Mari will buy a personal computer.” indicates that the participants have rejected Mari-san (henceforth “NP2”) as a possible answer to the preceding empty subject sentence. This NP2-rejection leads to the two possible interpretations: NP1 (Kenji-kun) or a third party (other than NP1 and NP2). Since the rejection of NP2 includes NP1 interpretation, it might support NP1 preference indirectly and secondarily. That is, the YES responses to NP1/NP2 support NP1/NP2 preference directly, whereas NO responses to NP1/NP2 support NP2/NP1 preference indirectly and secondarily.

Following the on-line tasks, the participants were asked whether they knew the subject/object control verbs used in the experiments. Thirty participants were divided into three groups: beginner level (ten participants who hardly knew any of the matrix verbs), intermediate level (ten participants who knew about half of the matrix verbs), and advanced level (ten participants who knew most of the matrix verbs) (see Table 5-1). There were exactly ten participants in each group.

The average Japanese study time of participants at the beginner level was 216 hours (24 weeks × 6 times × 1.5 hours), 720 hours (80 weeks × 6 times × 1.5 hours) for participants at the
intermediate level, and 1050 hours (140 weeks × 5 times × 1.5 hours) for participants at the advanced level.

Table 5-1 shows the results of the off-line experiment. In one list, there were five subject control verbs and five object control verbs. Since there were ten participants in this experiment, the total number of subject control verbs was fifty (5 verbs × 10 participants), and the total number of object control verbs was also fifty (5 verbs × 10 participants).

Table 5-1: Number of acquired verbs (AV) and unacquired verbs (UV)

<table>
<thead>
<tr>
<th></th>
<th>Beginner level</th>
<th>Intermediate level</th>
<th>Advanced level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AV</td>
<td>UV</td>
<td>AV</td>
</tr>
<tr>
<td>Subject control verb</td>
<td>12</td>
<td>38</td>
<td>31</td>
</tr>
<tr>
<td>Object control verb</td>
<td>5</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>83</td>
<td>51</td>
</tr>
</tbody>
</table>

Next, I will discuss the effect of word order in the experiment. The experimental sentences are divided into two conditions, SOV word order and OSV word order. A crucial difference between the two word orders is that the nearest noun phrase to the empty subject is different in the two types of sentences.

5.1.3 SOV word order

5.1.3.1 Prediction

Unacquired verbs

When the participants read the sentences including unacquired verbs, if no strategy is
employed at all, the number of YES and NO responses to the question “Kenji will buy a personal computer.” would be about the same, and the number of YES and NO responses to the question “Mari will buy a personal computer.” would also be about the same.

As discussed in the previous Chapters, various possibilities are available with regard to the insignificant difference: the participants do not use any strategies completely, or some competing strategies are used randomly, strategies used may differ due to individual variations, or depending on the experimental sentences. Therefore, I will study the overall data, but not the data of individuals. If the result turns out to be insignificant, there are two possibilities: participants do not use any strategies completely, or some competing strategies are used randomly.

If participants do employ some strategies to “guess” the sentence, the only means is to use the information of the nouns with a case particle.

i): Perceptual strategy – recency strategy

If the recency strategy is used by the participants, it is predicted that the empty subject would be filled by the nearest filler (NP2: Mari-san), and the YES responses for the question “Mari will buy a personal computer.” would increase. The YES responses for Mari-san are a direct indication of NP2 preference. Furthermore, more NO responses for the question “Kenji will buy a personal computer.” are expected. The NO responses for Kenji-kun are an indirect and secondary indication of NP2 preference, as it implies NP1 (Kenji-kun)-rejection.

ii): Perceptual strategy – primacy strategy

If the primacy strategy is used by the participants, it is predicted that the empty subject would be filled by the sentence-initial filler (NP1: Kenji-kun); the YES responses for Kenji-kun
and NO responses for Mari-san should increase.

iii): Linguistic strategy – case-marker ga preference

If information from the nominative case-marker ga is used, Kenji-kun which is attached with the case-marker ga would fill the empty subject with a high priority. The YES responses for Kenji-kun and NO responses for Mari-san should increase.

Summary

The recency strategy and primacy strategy are “Perceptual strategies”, while case-marker ga preference is a kind of “Linguistic strategy”. The predictions of the unacquired verbs are shown in the following table.

Table 5-2: Predictions of unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>no strategy employed</th>
<th>YES responses = NO responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>some strategies employed</td>
<td>recency strategy</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Kenji-kun) &gt; NO NP2 (Mari-san)</td>
</tr>
<tr>
<td></td>
<td>primary strategy</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Kenji-kun) &lt; NO NP2 (Mari-san)</td>
</tr>
<tr>
<td></td>
<td>linguistic strategy</td>
</tr>
<tr>
<td></td>
<td>NO NP1 (Kenji-kun) &lt; NO NP2 (Mari-san)</td>
</tr>
</tbody>
</table>

Acquired verbs

When the participants read the experimental sentences with an acquired matrix verb, the
correct rate should be high. It is predicted that empty subject sentences with an acquired matrix verb are processed in a manner similar to Japanese native speakers who can classify the sentence type correctly.

In Japanese, the matrix verb appears at the end of the sentence. When the matrix verb is input, the strategies employed by the participants could be verified. If the participants use the same strategies as Japanese native speakers do, then the empty subject would be filled by the subject at first. When the matrix verb is input, the reading times (RTs) of object control verbs would be longer than that of subject control verbs, because the empty subject is corresponded to subject control verb. However, reanalysis would be needed when the object control verb is input. The predictions of acquired verbs are shown below.

Table 5-3: Predictions of RTs and correct answers for acquired verbs in SOV order

<table>
<thead>
<tr>
<th>RTs of P5</th>
<th>(55a) &lt; (55b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of correct answers</td>
<td>high</td>
</tr>
</tbody>
</table>

5.1.3.2 Results and discussion

The participants in this experiment are English native speakers who are currently studying Japanese. Unlike English, there are case-marking particles in Japanese and the word order is also different. It is very interesting to see how English native speakers would process Japanese empty subject sentences.

Beginner level

The results of beginner level participants in the SOV word order are shown below.
Table 5-4: Questions and YES/NO responses by beginner on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, distant filler)</td>
<td>15 (39%)</td>
<td>23 (61%)</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, recent filler)</td>
<td>35 (78%)</td>
<td>10 (22%)</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>50</td>
<td>33</td>
<td>83</td>
<td></td>
</tr>
</tbody>
</table>

(Fisher's exact test: \( p < .001 \))

As shown in Table 5-4, there is a significant difference between responses given to the subject control sentence questions and object control sentence questions (Fisher's exact test, \( n=83, p = .0006, p < .05 \)). A higher ratio of YES responses for NP2 (78%) is observed. The result shows that beginners exhibited a marked bias toward NP2 (Mari-san, recent filler) preference. NP2 (Mari-san) is the nearest filler to PRO, so "recency" may be an important reason. This result is consistent with the prediction that participants use the 'recency strategy' to process empty subject sentences, instead of the 'primacy strategy' and the 'case-marker ga'. We can therefore draw a conclusion from this result that beginners use the 'recency strategy', where the nearest filler NP2 (Mari-san) is preferred to fill the empty subject. The strategy employed in the beginner level for the SOV word order is shown below.

(56) Strategy used by beginners for SOV order:

perceptual strategy: recency strategy
Intermediate level

The results of intermediate level learners for the SOV word order are shown below.

Table 5-5: Questions and YES/NO responses by intermediate level learners on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, distant filler)</td>
<td>YES</td>
<td>13 (68%)</td>
<td>6 (32%)</td>
<td>19</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, recent filler)</td>
<td>YES</td>
<td>9 (30%)</td>
<td>21 (70%)</td>
<td>30</td>
</tr>
<tr>
<td>total</td>
<td>YES</td>
<td>22</td>
<td>27</td>
<td>49</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: $p<.05$)

From Table 5-5, there is a significant difference between responses given to subject control sentence questions and object control sentence questions (Fisher’s exact test, $n=49$, $p=.017$, $p<.05$). A higher ratio of YES NP1 (Kenji-kun, ga, distant filler) (68%) than the ratio of YES NP2 (Mari-san, recent filler) (30%) is observed. A strong NP1 (Kenji-kun) preference is found, contrary to the beginner level. There are two possible interpretations. One is that general-purpose strategies, such as the ‘primacy strategy’, are used. Since NP1 (Kenji-kun) appears at the beginning of the sentence, it stand out and participants give priority to NP1 (Kenji-kun) to fill the empty subject. Another interpretation is the use of linguistic strategies, such as ‘the case-marker $ga$’. The prominence of case-marker $ga$ causes participants to give priority to NP1 (Kenji-kun) to fill the empty subject. The strategies employed in the intermediate level for the SOV word order are shown below.
Strategies used by intermediate level learners for SOV order:

a. perceptual strategy: primacy strategy

b. linguistic strategy: case-marker *ga* preference

Advanced level

The results of advanced level learners for the SOV word order are shown below.

Table 5-6: Questions and YES/NO responses by advanced level learners on unacquired verbs in SOV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (<em>Kenji-kun, ga</em>-subject, distant filler)</td>
<td></td>
<td>5 (71%)</td>
<td>2 (29%)</td>
<td>7</td>
</tr>
<tr>
<td>NP2 (<em>Mari-san, ni</em>-object, recent filler)</td>
<td></td>
<td>4 (36%)</td>
<td>7 (64%)</td>
<td>11</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>9</td>
<td>9</td>
<td>18</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: \(p = 0.3348\), n.s.)

From Table 5-6, the YES/NO responses do not show any significant difference (Fisher’s exact test, \(n=16, p=0.3348\)). A possibility is due to the larger number of acquired matrix verbs than unacquired ones at this stage. That is, the size of data for unacquired verbs is too small to be relied on. Thus, for these groups, only the data of acquired verbs should be considered.

Acquired verbs

The percentage of correct answers for acquired verbs are shown below.
Table 5-7: Percentage of correct answers for acquired verbs in SOV order

<table>
<thead>
<tr>
<th></th>
<th>Beginner level</th>
<th>Intermediate level</th>
<th>Advance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject control sentence</td>
<td>7/12 = 58%</td>
<td>20/31 = 65%</td>
<td>37/43 = 86%</td>
</tr>
<tr>
<td>Object control sentence</td>
<td>4/5 = 80%</td>
<td>14/20 = 70%</td>
<td>33/39 = 85%</td>
</tr>
<tr>
<td>$t$ test</td>
<td>$t(9) = .421$, $p = .684$ n.s.</td>
<td>$t(9) = .165$, $p = .873$ n.s.</td>
<td>$t(9) = .140$, $p = .891$ n.s.</td>
</tr>
</tbody>
</table>

Table 5-7 shows that the percentage of correct answers for object control sentences is higher than that for subject control sentence at the beginner level (subject control sentence 58% vs. object control sentence 80%), but the difference is not significant. The results may not be reliable as the number of items is too small.

At the intermediate level, the percentage of correct answers for subject control sentences is 65%, and that for object control sentences is 70%. The correct answer rate is not so high. This result shows that the intermediate level participants are not able to judge the questions correctly, even though they claimed they “knew” the matrix verbs.

The advanced level participants had a high rate of correct responses (subject control sentence 86%; object control sentence 85%). This result indicates that advanced level participants could judge the sentences correctly. This also shows that the advanced learners are able to use the control information of the matrix verbs correctly.

Next, I will discuss whether the RTs of subject control verbs is shorter than that of object control verbs, and whether the results would be similar to those of Japanese native speakers when the participants read the sentences with an acquired matrix verb. Since beginners acquired only a few verbs, I will not discuss the results of beginners here. Figure 5-1 and Figure 5-2 show the RTs of each phrase in the SOV word order for acquired verbs at the intermediate and
advanced levels. Because the matrix verbs used for the experimental sentences are different in the number of moras and characters (e.g., 約束した yakusokushita ‘promised’: mora 6, character 4, 求めた motometa ‘demanded’: mora 4, character 3), per mora and per character of acquired matrix verbs are measured. The results are shown in Table 5-8.

![Graph showing reading times (ms) for each phrase for acquired verbs in SOV order at intermediate level.](image)

**Figure 5-1:** RTs of each phrase for acquired verbs in SOV order at intermediate level
Table 5-8: RTs of acquired verbs (per mora and per character) in SOV order

<table>
<thead>
<tr>
<th></th>
<th>S-control verb</th>
<th>O-control verb</th>
<th></th>
<th>S-control verb</th>
<th>O-control verb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate level</td>
<td>523ms</td>
<td>501ms</td>
<td></td>
<td>625ms</td>
<td>535ms</td>
</tr>
<tr>
<td></td>
<td><em>t</em> = .469, <em>p</em> = .650 n.s.</td>
<td></td>
<td></td>
<td><em>t</em> = 1.555, <em>p</em> = .154 n.s.</td>
<td></td>
</tr>
<tr>
<td>Advanced level</td>
<td>471ms</td>
<td>540ms</td>
<td></td>
<td>565ms</td>
<td>661ms</td>
</tr>
<tr>
<td></td>
<td><em>t</em> = 1.368, <em>p</em> = .205 n.s.</td>
<td></td>
<td></td>
<td><em>t</em> = 1.327, <em>p</em> = .217 n.s.</td>
<td></td>
</tr>
</tbody>
</table>

Table 5-8 shows the RTs (per mora and per character) of each acquired matrix verb at the intermediate and advanced levels. At the intermediate level, the RTs of the subject control verb is longer than that of the object control verb both in one mora (subject control verb 523ms vs. object control verb 501ms) and one character (subject control verb 625ms vs. object control verb 535ms). However, the difference is not significant. At the advanced level, the RTs of the
object control verb is longer than that of the subject control verb both in one mora (subject control verb 471ms vs. object control verb 540ms) and one character (subject control verb 565ms vs. object control verb 661ms). Again, the difference is not significant.

At the intermediate level, there is no significant difference in the RTs of the matrix verbs both in mora and character. These results do not correspond to those for Japanese native speakers. The participants at the intermediate level might be influenced by unacquired verbs as beginners did, though their matrix verb acquisition levels are more advanced than the beginners.

Table 5-8 shows that there is no significant difference in the RTs of the matrix verbs in both mora and character among advanced level participants. These results are not consistent with the previous prediction that advanced participants should show the "subject preference" effect. Longer RTs of object control verbs, which are an indicator of the "subject preference" effect, are not observed. Thus, we cannot conclude that advanced level participants used the "subject preference" strategy to fill the gap. However, the word order might not be revealing the whole picture. I will discuss this problem in the OSV word order again.

From the results of percentage of correct answer and the RTs of acquired verbs, the strategies used by intermediate and advanced learners for acquired verbs are shown below.

Table 5-9: Strategies used by intermediate and advanced level learners for acquired verbs in SOV order

<table>
<thead>
<tr>
<th>Intermediate level</th>
<th>different from Japanese native speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced level</td>
<td>not clear</td>
</tr>
</tbody>
</table>

From these results of SOV order control sentences, we came to know that the 'recency strategy' was used in the early stage of L2 learners. Whether general-purpose strategies (i.e.,
‘primacy strategy’) or linguistic strategies (i.e., ‘case-marker ga preference’) were used in the intermediate stage of L2 is uncertain. Moreover, whether the “subject preference” strategy was used by advanced learners could not be observed. How would it be if the word order is different? The NP1 (Kenji-kun) would become the nearest filler in the OSV order. In this case, would the ‘recency strategy’ apply to beginner learners, as in the SOV order? Which strategy would be used at the intermediate level? Could the “subject preference” effect be observed in advanced learners in the OSV order?

5.1.4 OSV word order

In the OSV word order, NP1 (Kenji-kun) and NP2 (Mari-san) are swapped. Different from the SOV word order, NP1 (Kenji-kun) become the nearest filler to PRO, and NP2 (Mari-san) become the initial filler. Would the difference in word order lead to different results?

5.1.4.1 Prediction

As discussed above, when participants process sentences containing unacquired verbs, if no strategy is employed at all, the number of YES and NO responses to the question “Kenji will buy a personal computer.” will about the same, and the number of YES and NO responses to the question “Mari will buy a personal computer.” will also about the same. Also, the insignificant difference between the YES/NO responses may be attributed to the competing strategies. If participants do employ some strategies to “guess” the sentence, the only means is to use the information of nouns with a case particle.

i): Perceptual strategy – recency strategy

If general-purpose strategies, such as the recency strategy, are also used in the OSV word
order, then the number of YES responses for NP2 would increase. As an indirect and secondary indication, the NO responses for NP1 would also increase.

ii): Perceptual strategy – primacy strategy

If the primacy strategy is used by the participants, it is predicted that the empty subject would be filled by the sentence-initial filler (NP2: *Mari-san*). The YES responses for *Mari-san* and NO responses for *Kenji-kun* should increase.

iii): Linguistic strategy – case-marker *ga* preference

If information from the nominative case-marker *ga* is used in the OSV word order, the prediction would be the same as the SOV word order, and the empty subject would be filled by NP1 (*Kenji-kun*). The YES responses for *Kenji-kun* and NO responses for *Mari-san* should increase.

Summary

The recency strategy and primacy strategy are “Perceptual strategies”, while case-marker *ga* preference is a kind of “Linguistic strategy”. The predictions of unacquired verbs are shown in the following table.
Acquired verbs

When the participants read the experimental sentences with an acquired matrix verb, the prediction is the same as that of the SOV word order. The correct answer rate is expected to be high. It is assumed that the participants processed Japanese empty subject sentences with an acquired matrix verb in a similar manner to Japanese native speakers who can correctly classify the sentence type.

Thus, if the participants use the “subject preference” strategy as good as Japanese native speakers, the empty subject would be filled by the subject at first. When the matrix verb is shown, reanalysis would be needed if the matrix verb is an object control verb, but not when it is a subject control verb. Due to this reanalysis, the RTs of the object control verbs would be longer than that of subject control verbs.
Table 5-11: Predictions of RTs and correct answers for acquired verbs in OSV order

<table>
<thead>
<tr>
<th>RTs of P5</th>
<th>(55c) &lt; (55d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of correct answers</td>
<td>high</td>
</tr>
</tbody>
</table>

5.1.4.2 Results and discussion

How will the results of the OSV word order be? Would they be similar to the SOV results? Can the questions that remained unanswered in the SOV word order be solved in the OSV word order?

Beginner level

The results of beginner participants for the OSV word order are shown below.

Table 5-12: Questions and YES/NO responses by beginners on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td></td>
<td>21</td>
<td>17</td>
<td>38</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td></td>
<td>22</td>
<td>23</td>
<td>45</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>43</td>
<td>40</td>
<td>83</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: \( p = 0.6606, \text{n.s.} \))

From Table 5-12, the responses are not different between the sentence question types (Fisher’s exact test, \( n=83, p=0.6606 \)). From this result, it seems that beginners did not employ...
any strategies to “guess” the sentences. However, the results in the SOV word order showed that beginners employed some strategies to “guess” the sentences, this shows that some competing strategies could have made the difference between NP1 preference and NP2 preference insignificant. The ‘recency strategy’ and ‘case-marker ga preference’ enhanced NP1 preference, whereas the ‘primacy strategy’ made NP2 preference stronger. The strategies employed in the beginner level for the OSV word order are shown below.

(58) Strategies used by beginners for OSV order:

a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy
b. perceptual strategy: primacy strategy + linguistic strategy: case-marker ga preference

Intermediate level

The results of intermediate level learners for the OSV word order are shown below.

Table 5-13: Questions and YES/NO responses by intermediate level learners on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td></td>
<td>12 (63%)</td>
<td>7 (37%)</td>
<td>19</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td></td>
<td>10 (33%)</td>
<td>20 (67%)</td>
<td>30</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>22</td>
<td>27</td>
<td>49</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: .05<p<.10)

The YES/NO responses are different between the sentence question types, but do not
reach a significant level (Fisher’s exact test, n=49, p=0.0757). Since the results in the SOV word order showed that intermediate level participants employed some strategies to “guess” the sentences, there could be some competing strategies that have made the difference between NP1 preference and NP2 preference insignificant in the OSV word order. The factors that made NP1 preference strong are hypothesized to be the ‘recency strategy’ or ‘case-marker ga preference’. The factors that made NP2 preference strong are expected to be the ‘primacy strategy’. Because these strategies are used together, a significant difference is not observed between NP1 preference and NP2 preference. The strategies employed in the intermediate level for the OSV word order are shown below.

(59) Strategies used by intermediate level learners for OSV order:

a. perceptual strategy: recency strategy + perceptual strategy: primacy strategy

b. perceptual strategy: primacy strategy + linguistic strategy: case-marker ga preference

Advanced level

The results of advanced level learners for the OSV word order are shown below.

Table 5-14: Questions and YES/NO responses by advanced level learners on unacquired verbs in OSV order

<table>
<thead>
<tr>
<th>subject NP of question sentence</th>
<th>response</th>
<th>YES</th>
<th>NO</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 (Kenji-kun, ga-subject, recent filler)</td>
<td></td>
<td>6 (36%)</td>
<td>1 (14%)</td>
<td>7</td>
</tr>
<tr>
<td>NP2 (Mari-san, ni-object, distant filler)</td>
<td></td>
<td>6 (55%)</td>
<td>5 (45%)</td>
<td>11</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>9</td>
<td>9</td>
<td>18</td>
</tr>
</tbody>
</table>

(Fisher’s exact test: p=0.3156, n.s.)
The results are the same as the SOV word order. The number of YES/NO responses do not show any significant difference (Fisher's exact test, \( n=18, p=.3156 \)), as shown in Table 5-14. As discussed above, there is a possibility that there are more acquired matrix verbs than unacquired ones at this stage. That is, the size of data for unacquired verbs is too small to be relied on. Thus, for these participants, only the data of acquired verbs should be considered.

Acquired verbs

The percentage of correct answers for acquired verbs are shown below.

Table 5-15: Percentage of correct answers for acquired verbs in OSV order

<table>
<thead>
<tr>
<th></th>
<th>Beginner level</th>
<th>Intermediate level</th>
<th>Advanced level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject control sentence</td>
<td>6/12 = 50%</td>
<td>21/31 = 68%</td>
<td>35/43 = 81%</td>
</tr>
<tr>
<td>Object control sentence</td>
<td>4/5 = 80%</td>
<td>13/20 = 65%</td>
<td>32/39 = 82%</td>
</tr>
<tr>
<td>( t ) test</td>
<td>( t(9) = .646, ) ( p = .534 ) n.s.</td>
<td>( t(9) = .755, ) ( p = .470 ) n.s.</td>
<td>( t(9) = .308, ) ( p = .765 ) n.s.</td>
</tr>
</tbody>
</table>

Table 5-15 is the percentage of correct answers for acquired verbs in the OSV word order sentences. At the beginner level, the percentage of correct answers for object control sentences is higher than that of subject control sentences as well as the SOV word order (subject control sentence 50%, object control sentence 80%). However, the difference is not significant. As discussed above, the results may not be reliable as the number of items is too small.

At the intermediate level, the percentage of subject control sentences is 68%, and that of object control sentence is 65%. The difference is not significant. The result is the same as the SOV word order, in which the correct answer rate is not so high. This result shows that the
intermediate level participants are not able to judge the question correctly, even though they claimed they “knew” the matrix verbs.

The advanced level participants had a high rate of correct responses (subject control sentence 81%; Object control sentence 82%). This result indicates that advanced level participants could judge the sentences correctly. This also shows that the advanced learners are able to use the control information of the matrix verbs correctly.

Next, I will discuss whether the RTs of subject control verbs is shorter than that of object control verbs, and whether the results would be similar to Japanese native speakers if the participants read the sentences with an acquired matrix verbs. Since beginners acquired only a few verbs, I will not discuss the results of beginners here. Figure 5-3 and Figure 5-4 show the RTs of each phrase in the OSV word order for acquired verbs at the intermediate and advanced levels. Table 5-16 is the results for RTs of acquired matrix verbs per mora and pre character at the intermediate and advanced levels.

Figure 5-3: RTs of each phrase for acquired verbs in OSV order at intermediate level
Figure 5-4: RTs of each phrase for acquired verbs in OSV order at advanced level

Table 5-16: RTs of acquired verbs (per mora and per character) in OSV order

<table>
<thead>
<tr>
<th></th>
<th>mora</th>
<th>character</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S-control verb</td>
<td>O-control verb</td>
</tr>
<tr>
<td>Intermediate level</td>
<td>664ms</td>
<td>704ms</td>
</tr>
<tr>
<td></td>
<td>(t_{(9)}=0.462,\ p=0.655 \text{ n.s.})</td>
<td>(t_{(9)}=0.058,\ p=0.955 \text{ n.s.})</td>
</tr>
<tr>
<td>Advanced level</td>
<td>442ms</td>
<td>652ms</td>
</tr>
<tr>
<td></td>
<td>(t_{(9)}=3.698,\ p&lt;0.01)</td>
<td>(t_{(9)}=3.118,\ p&lt;0.05)</td>
</tr>
</tbody>
</table>

Table 5-16 is the RTs (per mora and per character) of acquired matrix verbs in the OSV word order. At the intermediate level, the RTs of the object control verb is longer than the subject control verb both in one mora (subject control verb 664ms vs. object control verb 704ms) and one character (subject control verb 763ms vs. object control verb 768ms). However, the difference is not significant. Similar to the SOV word order, these results do not correspond
Contrary to the SOV word order, at the advanced level, the RTs of the subject control verb is also longer than subject control verb both in one mora (subject control verb 442ms vs. object control verb 652ms) and one character (subject control verb 616ms vs. object control verb 796ms), and a significant difference in the RTs of the matrix verb is observed both in mora and character. These results are consistent with the prediction that advanced level participants show the "subject preference" effect, and suggest that the empty subject would be filled by the subject first. When the object control verb is input, a reanalysis is needed, while reanalysis is not needed when the subject control verb is input.

However, why is the significant difference in RTs of the verb not observed in the SOV word order? This result is just like that of Japanese grade-schoolers. It is probably because the parsing cost is higher for the OSV word order than the SOV word order. There is no room to process concurrently when the matrix verb is input in the OSV order. Thus, "subject preference" effect easily became prominent in the OSV order.

From the results of percentage of correct answer and the RTs of acquired verbs, the strategies used by intermediate and advanced learners for acquired verbs are shown below.

Table 5-17: Strategies used by intermediate and advanced level learners for acquired verbs in OSV order

<table>
<thead>
<tr>
<th>Intermediate level</th>
<th>different from Japanese native speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced level</td>
<td>linguistic strategy: subject preference</td>
</tr>
</tbody>
</table>

From results of the OSV order empty subject sentences, it can be concluded that general-purpose strategies (i.e., 'recency strategy', 'primacy strategy') and linguistic strategies...
(i.e., 'case-marker ga preference') are used in the early stage of L2 learner. The same strategies used by the beginners are used in the intermediate stage, too. And eventually shift to the linguistic strategy (i.e., 'subject preference') in the advanced stage.

Next, I will summarize the results of the SOV and OSV word order, and describe the strategies employed in each stage.

5.1.5 General discussion from SOV and OSV orders

Beginner level

From table 5-4, in the SOV word order, the higher ratio of YES responses for NP2 (Mari-san, recent filler) (78%) is a direct indication for the 'recent strategy'. However, in the OSV word order, the ratio of the YES responses for NP1 (Kenji-kun, recent filler) (55%) is higher than the YES responses for NP2 (49%), but this do not reach a significant difference (Table 5-12). To explain the results of the OSV word order, the beginners is assumed to have employed 'recency strategy + primacy strategy' or 'case-marker ga preference + primacy strategy' (see (58)). This result does not support the 'recency strategy' in the SOV word order. That is, the results of the OSV condition are not consistent with the results of the SOV order condition, in which the 'recency strategy' is supposed to be used by the beginners. Therefore, it is necessary to reconsider the result of the SOV word order. In the SOV word order, the NP2 (Mari-san) was preferred by the beginners. Notice that the NP2 (Mari-san) is the nearest filler to the empty subject. The case-marker ni is also attached to it. If the beginners used both the recency strategy and information of the case-marker ni, the results of the SOV and OSV word order should then be coherent. In the SOV word order, the NP2 (Mari-san) is the nearest filler and have a case-marker ni. The ratio of YES NP2 or NO NP1 increased markedly. In the OSV word order, the NP2 (Mari-san) is at the beginning of sentence, and is not the nearest filler to
the empty subject. The information of the case-marker *ni* was competing with the recency strategy, so the difference between NP1 responses and NP2 responses was not significant.

Why did participants at the beginner level use the case-marker *ni*? The participants of this experiment were English native speakers, who might have assumed that the case-marker *ni* corresponded to the preposition *to* in English. However, there is no element that corresponds to the case-marker particle *ga* in English\(^\text{12}\). At the beginner level, the transfer from first language might be strong (cf., Brown 1973, Fries 1945, Lado 1964). If this is the case, then it might be that the influence of the case-marker *ni* was strong but the influence of the case-marker *ga* was weak. Therefore, there is a possibility that beginners used the case-marker *ni*. However, notice that information on the case-marker *ni*, which was employed by the beginners, is not the grammar of the target language (Japanese), because it is thought that beginners would only give priority to the noun phrase with the case-marker *ni* as it corresponds to preposition *to* in the grammatical system of the first language, English. That is, interference by the L2 learners’ first language is highly possible. As a piece of evidence, the beginners failed to employ the clue given by the case-marker *ga*, because there is no specific morpheme that corresponds to the case-marker *ga* in English. The strategies used by beginners in the SOV and OSV word orders are shown below.

Table 5-18: Summary of strategies by beginners for SOV and OSV orders

<table>
<thead>
<tr>
<th>Beginner level</th>
<th>perceptual strategy: recency strategy + case-marker <em>ni</em> preference (influence from English)</th>
</tr>
</thead>
</table>

\(^\text{12}\) For instance, the Japanese sentence “Taro-ga Hanako-ni hana-o ageta.” corresponds to the English sentence “Taro gave flower to Hanako.” There is no element that corresponds to the case-marker *ga* in English (*ga* – ∅), while the case-marker *ni* corresponds to *to* (*ni* – *to*).
Intermediate level

For the intermediate level participants, results for the SOV word order show that the NP1 (Kenji-kun, 'ga', initial filler) preference is higher than the NP2 (Mari-san, recent filler) preference. Therefore, the intermediate level participants seem to have employed either the 'primacy strategy' or 'case-marker ga preference' to "guess" the sentences that had an unacquired verb (see (57)).

In the OSV word order, the YES/NO responses are different between the sentence question types, but do not reach a significant level. The intermediate participants might have employed 'recency strategy + primacy strategy' or 'case-marker ga preference + primacy strategy' (see (59)).

The 'case-marker ga preference + primacy strategy' could account for the results of the SOV and OSV word order, when the intermediate level participants "guessed" the sentences with an unacquired verb.

Moreover, the percentage of correct answers for subject control sentences and object control sentences is not high (Table 5-7, SOV order, subject control sentence 65%, object control sentence 70%; Table 5-15, OSV order, subject control sentence 68%, object control sentence 65%). The difference is not significant. In addition, there is also no significant difference in the RTs of the matrix verbs in both mora and character, as can be seen from Table 5-8 and Table 5-16. These results didn't correspond to those of Japanese native speakers, who used the "subject preference" strategy. There is a possibility that some of the matrix verbs which intermediate level participants claimed to "know" were actually unacquired verbs. When they processed sentences with acquired verbs, they might have employed the same strategies that were used for the sentences with unacquired verbs. The strategies used by intermediate level learners in the SOV and OSV word orders are shown below.
Table 5-19: Summary of strategies by intermediate level learners for SOV and OSV orders

<table>
<thead>
<tr>
<th>Intermediate level</th>
<th>i) perceptual strategy: primacy strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ii) linguistic strategy: case-marker ga preference</td>
</tr>
</tbody>
</table>

**Advanced level**

For advanced level learners, when they read sentences with unacquired verbs, the number of YES/NO responses to the sentences type questions are about the same (see Table 5-6 and Table 5-14). These results show that advanced level participants did not use any strategies to process the sentences. As discussed above, another possibility is that there were more acquired matrix verbs than unacquired ones at this stage. That is, the size of data for unacquired verbs was too small to be relied on. Thus, for advanced level learners, the data of acquired verbs should be considered.

Among the advanced level participants, the percentage of correct responses is high (Table 5-7, SOV order, subject control sentence 86%, object control sentence 85%, Table 5-15, OSV order, subject control sentence 81%, object control sentence 82%). These results indicate that advanced level participants could judge the sentences correctly. In other words, advanced learners could use the control information of matrix verb correctly.

Contrary to the result for the SOV word order (Table 5-8), advanced learners showed significant difference in the RTs of the matrix verb both in mora and character in the OSV word order (Table 5-16). The results of the OSV word order are consistent with the prediction that advanced level participants show the “subject preference” effect, suggesting that the empty subject would be filled by the subject first. When the object control verb was input, a reanalysis was needed, while reanalysis was not needed when the subject control verb was input. As
discussed above, since the parsing cost was higher for the OSV word order than the SOV word order, there was no room to process concurrently when the matrix verb was input in the OSV order. Thus, “subject preference” effect easily became prominent in the OSV order. The strategy used by the advanced level learners in the SOV and OSV word orders is shown below.

Table 5-20: Summary of strategy by advanced level learners for SOV and OSV orders

<table>
<thead>
<tr>
<th>Advanced level</th>
<th>linguistic strategy: subject preference</th>
</tr>
</thead>
</table>

From the results of L2 Japanese learners, it can be concluded that a general-purpose strategy (i.e., ‘recency strategy’) and a linguistic strategy (i.e., ‘case-marker ni preference’) are used in the early stage of L2 learning, which shift to the use of a perceptual strategy (i.e., ‘primacy strategy’) and a linguistic strategy (i.e., case-marker ga preference) in the intermediate stage, and eventually to a linguistic strategy (i.e., ‘subject preference’) in the advanced stage.

Several issues remain to be dealt with. Why is the case-marker ni used at the beginner level, and why is there a shift to using the case-marker ga at the intermediate level? How is it different from the Japanese grade-schoolers’ results? Does the DSFS hypothesis also apply to L2 Japanese learners? I will discuss these issues in the next section.

5.2 Concluding remarks

At the beginner level, learners employed a general-purpose strategy (i.e., ‘recency strategy’) and a linguistic strategy (i.e., ‘case-marker ni preference’) to “guess” the sentences. As discussed above, the participants of this experiment were English native speakers, and the case-marker ni corresponds to to in English. However, there is no element that corresponds to
the case-marker *ga* in English. At the beginner level, the transfer from first language might be strong.

For intermediate learners, they employed a different “Perceptual strategy” (i.e., ‘primacy strategy’) and “Linguistic strategy” (i.e., ‘case-marker *ga* preference’) to process the sentences. The beginner participants utilized the grammar that they could see (correspondence between the case-marker *ni* (Japanese) and *to* (English)) to process the empty subject sentences, while the intermediate participants, whose acquisition level was higher than the beginner participants, utilized the grammar that they could not see (the case-marker *ga* (Japanese) – ∅ (English)) to process empty subject sentences. Therefore, the strategies changed from *ni*-strategy to *ga*-strategy at the intermediate level.

As for advanced learners, the percentage of correct answers was high in both the SOV word order and OSV word order. These results indicate that advanced level participants could judge the sentences correctly. However, no significant difference in RTs of the matrix verb was observed in advanced level participants, both per mora and per character in the SOV word order, while a significant difference was observed, both per mora and per character, in the OSV word order. The same result was also observed in the higher-grade children of L1 Japanese (see Chapter 3). Since the parsing cost should be higher for the OSV word order than the SOV word order, there may be not sufficient mental resources to process all possibilities at the same time when the matrix verb was input in the OSV condition. The lack of resources could have caused the higher prominence of the “subject preference” effect.

The parsing strategies used at different verb acquisition levels are shown below.
In conclusion, native English learners who are beginners of Japanese used general-purpose strategies, such as the 'recency strategy', and linguistic strategies (first language) such as the case-marker *ni* effect to process empty subject sentences. These shifted to the 'primacy strategy' and case-marker *ga* effect at the intermediate stage, and subsequently switched to the "subject preference" strategy in the advanced stage.

At the beginner level, it seems that there is heavy influence from their first language. There is no case-marking particle in English (unlike Japanese). It is likely that parameter reset of the case-marking particle does not happen easily when the Japanese learning period is short. Therefore, there was little influence from case-marker particles for the beginner level L2 learners. In addition, the case-marker *ga* has no counterparts in English, while case-marker *ni* corresponds to the English preposition *to*, and this is a possible reason that leads to the NP2 (*Mari-san, ni*) preference. In a word, we may say the L2 beginners did not use Japanese grammar to process the Japanese empty subject sentences, but instead used English-like grammar.

On the other hand, the acquisition level of intermediate participants was higher than the
beginners. The possibility of parameter resetting of case-marker particles was high. Therefore, it is likely that the intermediate learners used the case-marker ga to process the sentence. The result of this experiment supported this explanation.

The acquisition level of advanced learners was high. Therefore, it is not surprising that advanced learners used the same parsing strategy as Japanese native speakers.

Below is a summary of results from L2 Chinese and L2 Japanese learners.

Graph 5-2: The results of L2 Chinese and L2 Japanese

Now, I will answer the questions set forth at the beginning of this chapter and Chapter 4.

i) Are “Perceptual strategies” observed in participants who have higher cognitive ability?

From Graph 5-1, even in participants who had higher cognitive ability, “Perceptual strategies” were observed at a lower proficiency level. The same shift of parsing strategies
applies to L1 Chinese, L1 Japanese and L2 Chinese, in which the recency strategy was used earlier than the primacy strategy. That is, even at the stage of higher cognitive ability, the primacy strategy was slower than the recency strategy. Therefore, it is easier to use the recency strategy than the primacy strategy. As the recency strategy is unrelated to memory capacity, while the primacy strategy is, the parser has to remember the beginning elements and process the following parts of a sentence, and this causes the parsing load to increase. Therefore, the parser will select an easier strategy to “guess” the sentences at the earlier stage.

ii) Does first language influence parsing?

From the results of beginners, the use of the case-marker *ni* shows that the first language does influence parsing.

iii) Do participants of higher proficiency use the same strategy employed by Japanese native speakers?

As discussed above, the participants of higher proficiency showed the same tendency as Japanese native speakers in processing the sentences.

From the above discussion, the results of English L2 learners of Japanese indicated the same parsing pattern as Japanese grade-schoolers: a general-purpose strategy is used when the acquisition level of verbs is low, which shifts to a mixed use of general-purpose and linguistic strategies in the intermediate stage, followed by a shift to linguistic strategies when the acquisition level of the verb is high. In a word, the results of this experiment supported the DSPS hypothesis that parsing strategies shift from “Perceptual strategies” to “Linguistic strategies”.

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Chapter 6: Conclusion

The research history of parsing (sentence processing) can be roughly divided into three stages. The first stage is the "Derivational Theory of Complexity, DTC" in the 1960's, the second stage is the "Perceptual strategy" in the 1970's, and the third is the "Transparency hypothesis" after the 1980's. The research of DTC hit its end because of the research shift in Generative Grammar.

In the current study, I proposed that the study on parsing enters its fourth stage, where parsing is viewed from the L1 and L2 acquisition perspective. The relationship between parsing and language acquisition is stated below by the "Developmental Shift of Parsing Strategies (DSPS)" hypothesis:

(60) Developmental Shift of Parsing Strategies hypothesis:

The parsing strategies shift from "Perceptual strategy" to "Linguistic strategy" along the development of linguistic knowledge.

In order to verify this hypothesis, I conducted a series of experiments on the processing of empty subject sentences in several languages.

In Chapter 1, I reviewed the experimental literature for similar constructions in English, Japanese and Chinese, and presented the theoretical incompatibility between the "Perceptual strategy" and "Transparency hypothesis".

Two ideas have been proposed in previous studies on the processing of empty subject sentences. One is the Most Recent Filler Strategy (MRFS), in which a parser fills the gap with the nearest filler. The other is the "Transparency hypothesis", in which a parser fills the gap by
referring to some linguistic strategies.

Frazier et al. (1983) claim that the MRFS is a general strategy, and enumerated a lot of evidences to support the theory. They further suggest that it is a cross-linguistic phenomenon. However, the results from the processing of Japanese and Chinese empty subject sentences did not support the MRFS. Instead, the results support the “Transparency hypothesis”, as shown by the “subject preference” effect or “immediate use of matrix verb”, which emerge when the parser attempts to fill the gap.

Note that the MRFS is used during the delay of verb control information. The delay of verb control information has been discussed in the literature but no conclusion has been reached. Experiments in Japanese empty subject sentence processing did not test the delay of verb control information, but only verified MRFS, where the verb is located at the end of sentence. Although experiment findings on Chinese suggest that the control information of verbs is utilized immediately, whether MRFS exists or not cannot be verified, since the control information of a verb is used immediately before MRFS. Therefore, it is necessary to verify whether MRFS really works in a situation where control information is unavailable, i.e., when the meaning of the verb is not fully understood by the reader. This could happen in two groups of people, children (L1) and foreign language (L2) learners who have not yet learned the meaning of the verbs.

Chapter 2 introduced an experiment from the perspective of L1 acquisition in Chinese. From the results of the experiments, it is clear that first graders in elementary schools, who have not acquired the matrix verbs and have relatively lower cognitive ability, preferred using the “recency strategy” to fill the empty subject. That is, non-linguistic and general-purpose strategies are utilized at the earlier stage of language development.

Both linguistic strategy (i.e., ‘the verb shuo’) and non-linguistic strategy (i.e., ‘recency
strategy') are utilized in a mixed way in the second grade, and a different combination of linguistic strategy (i.e., 'the verb *shuo*') and non-linguistic strategy (i.e., 'primacy strategy') are utilized by the third and fourth graders who are more advanced in linguistic ability and cognitive ability than the first graders.

The fifth graders, who have acquired all the matrix verbs, used the control information on the verb to process the sentences. Thus, verb control information (linguistic strategy) becomes available at a later stage of language development.

The above results show that parsing strategy shifts from non-linguistic (general) to linguistic (specific) ones as language proficiency develops. I named this the DSPS hypothesis.

If the DSPS hypothesis is correct, it will apply to different languages. Japanese is different from Chinese in that case-marking particles are attached to the nouns. In Japanese, the possibility that the case-marking particles are used even at the early stage of language development is high.

To verify whether the DSPS hypothesis applies to Japanese, Chapter 3 discussed an experiment conducted on Japanese-speaking school children. The first graders have a low acquisition level of the matrix verbs. They utilized "Perceptual strategies" (i.e., 'recency strategy' or 'primacy strategy') to process the empty subject sentences. The effect of the case-marker *ga* is more prominent among the second graders. Strategies of empty subject processing becomes more complex and mixed in the third and fourth grades. In the fifth grade, "subject preference" effect becomes prominent.

The experiments on Japanese children suggest that the parsing strategy shifts from "Perceptual strategies" to "Linguistic strategies" as children acquired more linguistic knowledge, such as the lexical information of control verbs. This is another piece of strong evidence that supports the DSPS hypothesis.
Chapters 2 and 3 discussed the DSPS hypothesis from the perspective of first language acquisition. Chapters 4 and 5 further attempted to verify the universality of the DSPS hypothesis from the perspective of second language acquisition. The participants are adults in L2, whose cognitive ability is well-developed. Studies are conducted to verify whether "Perceptual strategies" are also observed at a stage where matrix verbs in L2 have not been acquired. Also, if the results of L2 differing from those of L1, whether the difference is caused by the influence of first language.

Chapter 4 introduced an experiment from the perspective of L2 acquisition. The results show that English native speakers learning Chinese make use of a general-purpose strategy, such as the position information (i.e., 'recency strategy', 'primacy strategy'), at the earlier stages of L2 learning, followed by utilizing a general-purpose strategy (i.e., 'primacy strategy') and linguistic strategy (i.e., 'the verb shuo') at the intermediate stage of L2 learning, and a linguistic strategy based on verb information (i.e., immediate use of the verb control information) at a later stage of L2 learning. It was observed that in L2 learning, the parsing strategies shift from non-linguistic to linguistic ones as the learner's linguistic knowledge expands. These results are clear evidence that support the DSPS hypothesis.

The control information on the matrix verb is essential for the identification of an empty subject. In English and Chinese, the verb appears ahead of the empty subject. English native speakers learning Chinese do not need to reset mental parameters to process the empty subject sentences. However, in Japanese, the verb appears at the end of the sentence. Thus, English native speakers learning Japanese would have to reset parameters to process the empty subject sentences.

Moreover, Chinese and English noun phrases have no case-marker that signifies their grammatical relations with the verb. Due to the lack of case information, English native learners
of Chinese may use “Perceptual strategies” based on distance/position information to process Chinese empty subject sentences at the stage when the matrix verb has not been acquired. In contrast, Japanese is a language which uses case-marking particles. Case particles are added to the end of noun phrases. Therefore, even at the stage where the matrix verb has not yet been acquired, it is possible for L2 learners of Japanese to make use of such information provided by the case-marking particles (linguistic knowledge). Therefore, it is interesting to test whether the DSPS hypothesis applies to the processing of Japanese empty subject sentences by English native L2 Japanese learners.

Chapter 5 introduced an experiment conducted on English native speakers learning Japanese. Beginners used general-purpose strategies, such as the ‘recency strategy’, and linguistic strategies like the case-marker *ni* effect (not target language grammar) to process Japanese empty subject sentences. These shift to the case-marker *ga* effect and ‘primacy strategy’ at the intermediate stage, and subsequently to the “subject preference” strategy at the advanced level. That is, general-purpose strategies are used when the acquisition level of verbs is low, and these shift to linguistic strategies when the acquisition level of verb is high. In a word, the results from L2 learners also supported the DSPS hypothesis, which states that parsing strategies shift from “Perceptual strategies” to “Linguistic strategies”.

The results of children (L1) and second language (L2) learners are shown below.
In short, at least two types of strategies, namely non-linguistic strategies (or general strategies) and linguistic strategies (or language-specific strategies), are employed in parsing. In addition, the aforementioned experiments also suggest that parsing strategy shifts from non-linguistic to linguistic ones via a stage of mixture between both strategies. The DSPS hypothesis is supported by the first language acquisition and second language learning experiments. That is, the parser exploits non-linguistic, general, and universal strategies to process a sentence at the earlier stage before the grammar of a language is completely acquired. Such universal strategies might be something like the MRFS, as suggested by Frazier et al. (1983). Later on, the strategies shift to refer to linguistic knowledge. Some examples include the "immediate use of verb information" in the processing of Chinese empty subject sentences, and
the "subject preference" effect in the processing of Japanese empty subject sentences. These are language-specific strategies that are based on the characteristics of each individual language, and they can only be used after the grammar of a language is acquired.

However, we cannot rule out the possibility that general strategies are still being used even when a parser has acquired sufficient linguistic knowledge (i.e., Frazier et al. 1983). It becomes impossible to use linguistic information when the sentence is too complex or too long, and the parser may have to rely on general-purpose perceptual strategies in this case.

The shift of parsing strategies showed the same tendency, in which the recency strategy is used earlier than the primacy strategy. That is, even for participants with higher cognitive ability, the primacy strategy is utilized at a later stage than the recency strategy. Therefore, we can say that for learners whose linguistic knowledge is low, the recency strategy is more easily employed as compared to the primacy strategy. As the recency strategy is unrelated to memory capacity, while the primacy strategy is, the parser has to remember the beginning elements and process the following parts of a sentence, and this causes the parsing load to increase. Therefore, the parser will select an easier strategy to "guess" the sentences at the earlier stage.

To account for the shift in parsing strategies, the present thesis proposed the DSPS hypothesis. Experiments were conducted from the perspectives of children L1 acquisition and adult L2 learning on the processing of empty subject sentences in Chinese and Japanese. The DSPS hypothesis states that parsing strategies shift from "Perceptual strategies" to "Linguistic strategies" as the learner's linguistic knowledge expands. That is, the development of parsing strategy shifts from non-linguistic (general) to linguistic (specific) ones. However, the process of shift is characterized by the linguistic constructions of the target language for L1 and L2 learning. This thesis has succeeded in making contributions to clarify some aspects of the shift from "guessing" to "parsing" strategies through a number of psycholinguistic experiments.
Appendices

Appendix A: Dui-construction in Chinese

1. Dui-construction in Chinese

Chinese, similar to English, is a head-initial language. The matrix verb is basically located before PRO. Since Chinese is an SVO language, the control construction will be in the order of “Subject – Verb 1 – Object – [S PRO Verb 2]”. Note that if the Verb 1 is a transitive verb, the verb is most likely an object control verb, with very few exceptions (like promise in English). Due to the lack of transitive subject control verbs, I explored the relatively free prepositional phrase construction, which allows the structure “Subject – pre-Object – Verb 1 – [S PRO Verb 2]”. This structure allows the use of subject control verb and object control verb with parallel frequency. Moreover, this structure is parallel to English and Japanese structures where two fillers appear ahead of the verb.

Functional words, such as ba (preposed object marker), bei (passive marker), cong (from), dao (to), dui (toward), gei (for/to), gen (with), zai (at) etc. are traditionally considered prepositions in Chinese descriptive grammar. (cf. Liu et al. 1988, Ernst 1994). However, some researchers pointed out that these prepositions do exhibit considerably different behaviors (cf. Ernst 1994, Whitman et al. 2005). Next, I will introduce Ernst (1994) and Whitman et al. (2005) respectively, and explain why the proposition dui is chosen in this experiment.

1.1 Pseudo Preposition

1.1.1 Ernst 1994

Ernst (1994) studies the order of constructions with a temporal adverb and a prepositional phrase. It is suggested that the temporal adverb precedes some prepositions (dui, cong, dao, gen), as shown in (61) - (64), while the order is free when it co-occurs with other prepositions (ba, bei, zai, gei), as shown in (65) - (68).

(61) (Ernst 1994, (37))
   a. Jinrong zuotian dui ta xing le li.
      Jinrong yesterday to him do ASP ceremony
      ‘Yesterday Jinrong saluted him.’
   b. *Jinrong dui ta zuotian xing le li.
(62) (Ernst 1994, (35))
   a. Shujuan mingtian cong Feicheng qu Niuyue.
      Shujuan tomorrow from Philadelphia to N.Y.
      ‘Tomorrow Shujuan goes from Philadelphia to New York.’
   b. *Shujuan cong Feicheng mingtian qu Niuyue.
(63) (Ernst 1994, (34))
   a. Xiaoming zuotian dao wojia lai le.
      Xiaoming yesterday to my home come ASP
      ‘Yesterday Xiaoming came to my home.’
   b. *Xiaoming dao wojia zuotian lai le.
(64) (Ernst 1994, (36))
   a. Ta zuotian gen wo shuo hua le.
      He yesterday with me talk speech ASP
      ‘He spoke with me yesterday.’
   b. *Ta gen wo zuotian shuo hua le.
(65) (Ernst 1994, (17'))
   a. Ta zuotian ba fangzi mai dao le.
      S/he yesterday BA house sell off ASP
      ‘S/he sold the house yesterday.’
   b. Ta ba fangzi zuotian mai dao le.
The structure of constructions with *dui, cong, dao, gen* are shown in (69a), while the constructions with *ba, bei, zai, gei* are shown in (69b') and (69b")

Ernst (1994) divided Chinese prepositions into two groups according to the order of the adverb and the preposition. However, there is considerable individual variation in the judgment on examples (61) - (68). For instance, some native speakers find (66b) unacceptable, while (61b) and (64b) grammatical. Moreover, it is indeed possible to put an adverb, such as “tomorrow”, after the prepositions *dui, cong, dao, gen*.
Ernst's classification of prepositions by the location of temporal adverbs in prepositional constructions would not be appropriate if the sentences (70) - (73) are considered acceptable. However, Ernst brought out the point that prepositions have very different properties.

1.1.2 Whitman et al. 2005

Further to Ernst's findings, Whitman et al. (2005) described two ways to distinguish dui from ba by the following two criteria.

1.1.2.1 Can it be followed by a VP?

Whitman et al. claim that VP cannot occur after the preposition dui, while VP can occur after ba.

(74) (Whitman et al. 2005, (11))

   I towards Wangwu very have prejudice, towards Laoli also very have prejudice
   'I am very prejudiced against Wangwu and also against Laoli.'


c. *Wo dui [[Wangwu hen you yijian], [Laoli ye hen you yijian]].

(75) (Whitman et al. 2005, (9))

a. Mama ba [[di ca -le you ca], [zhuozi ma -le you ma]].
   Mom BA floor scrub-PERF again scrub table wipe-PERF again wipe
   'Mom again and again scrubbed the floor and again and again wiped the table.'


The behavior of dui in (74) contrasts sharply with (75), where dui and the immediately following NP form a constituent as a prepositional adjunct, i.e., [VP [PP dui Wangwu] [VP hen you yijian]], while ba continues to take the projection of the verb to its right as its complement. The examples of (75) show that there are two occurrences of preverbal object plus VP in ba constructions.

1.1.2.2 Can it become a modifier of a DP?

The second point that Whitman et al. claim is the difference between dui and ba is that dui can appear as a modifier of a relational DP, while ba cannot.

(76) a. [Zhangsan [PP dui [PP zhe-jian shi]] de anpai] bu tuodang
   Zhangsan towards this-CL matter DE arrangement NEG suitable
   'Zhangsan's arrangement of this matter is not suitable.'

b. *[Zhangsan [PP ba [PP zhe-jian shi]] de anpai] bu tuodang

As (76) illustrates, dui can introduce the object DP of the verb anpai in its nominal counterpart (76a), but ba cannot in (76b).

1.1.3 Summary

Prepositions are divided into two groups in the analysis of Ernst (1994). According to Ernst's
(1994) description, temporal adverbs must appear before some prepositions (dui, cong, dao, gen), while the position is free with other prepositions (ba, bei, zai, gei). Whitman et al. (2005) pointed out two pieces of evidence to show that the behavior of dui and ba is different.

In the following section, I will discuss whether Chinese prepositions can be placed at the beginning of a sentence. Thus, the structure “Subject - pre-Object - Verb 1 - [S PRO Verb 2]” could be rearranged to the order “Pre-Object - Subject - Verb 1 – [S PRO Verb 2]”. This changes the near filler to PRO.

1.2 Can prepositional phrase be fronted to the beginning of a sentence?
Here, I will verify whether prepositions such as ba (preposed object marker), bei (passive marker), cong (from), dao (to), dui (toward), gei (for/to), gen (with), and zai (at) can be used in the beginning of a sentence14.

(77) dui
Dui zhei-jian shi wo (dui zhei-jian shi) tichu le xin de kanfa
Dui this-CL matter I propose ASP new de perspective
‘On this issue, I proposed a new perspective.’

(78) cong
Cong jiali wo (cong jiali) dalai le yiben shu
Cong house I bring ASP one-CL book
‘From home, I brought a book.’

(79) dao
Dao xuexiao wo (dao xuexiao) cai yong le 30 fenzhong
Dao school I only use ASP 30minutes
‘To get to school, I spent only 30 minutes.’

(80) gen
Gen Zhangsan Lisi (gen Zhangsan) shuo le na-jian shi
Gen Zhangsan Lisi say ASP that-CL matter
‘With Zhangsan, Lisi talked about that matter.’

(81) zai
Zai zhishang ta (zai zhishang) xie le ji-ge zi
Zai paper he write ASP some-CL character
‘On a paper, he wrote some characters.’

(82) gei
Gei ta wo (gei ta) de le yi-ge dianhua
Gei him I call ASP a-CL telephone
‘To him, I made a phone call.’

(83) ba
a. *Ba pingguo wo (ba pingguo) chi le
Ba apple I eat ASP
‘I ate the apple.’
b. *Ba Lisi ta (ba Lisi) paoqi le
Ba Lisi she abandon ASP
‘She abandoned Lisi.’

14 Here, the important point is about whether preposition + NP can be placed at the beginning of the sentence. Whether the PP can be topicalized is beyond our concern.
From the examples above, it is clear that "ba" and "bei" are different from other prepositions. Neither "ba+NP" nor "bei+NP" can be put at the beginning of a sentence, as shown in (77)-(84). Therefore, the structure "Pre-Object - Subject - trace - Verb 1 - [S PRO Verb 2]" cannot be constructed by using "ba" and "bei". Next, I will examine whether the remaining prepositions can co-occur with the control verb.

1.3 Can it co-occur with a control verb?

In the above section, I have discussed that the prepositions such as "cong" (from), "dao" (to), "dui" (toward), "gei" (for/to), "gen" (with), and "zai" (at) can be placed at the beginning of a sentence. In this section, I will see whether these prepositions can co-occur with a control verb. That is, whether the structure "Subject - pre-Object - Verb 1 (control verb) - [S PRO Verb 2]" is possible.

From (85)-(90), no preposition except "dui", can co-occur with the control verb. That is, "dui" is the only preposition that allows both "Subject - pre-Object - Verb 1 (control verb) - [S PRO Verb 2]" and "Pre-Object - Subject - trace - Verb 1 (control verb) - [S PRO Verb 2]" orders.

In the next section, I will discuss the analysis of the preposition "dui" to clarify its characteristics of it.

1.4 Classification of the meaning of "dui"

There are a lot of studies about the meaning of the preposition "dui", e.g., Fu et al. (1997), Hou (1998). The functions of "dui" constructions are briefly summarized as follows.

(a) to signify the direction of an action
(b) to signify the object and target
(c) to signify the action relation

This is a trace arisen from fronting the preposition+NP to the beginning of the sentence. Here, I will not touch on whether it is PRO or pro or wh-trace or NP-trace.
d. to signify the related relation

I will explain each of them in the following sub-sections.

1.4.1 *Dui* that signifies the direction

Fu et al. (1997) explained *dui* for direction as follows.

"Generally, the object following *dui* is always a noun or a phrase that shows direction. For instance, ‘taishang (on the stand), shanshang (on the mountain), lianshang (on the face), chuangwai (outside the window), zheibian (here), and nabian (there)’ etc. The object following *dui* may be a noun that shows a location. For instance, ‘dongkou (mouth of the cave), liyuan (courtyard), dimian (ground), zhengmian (front), yuanchu (far away), and fangmenkou (doorway)’ etc. In sentences using the *dui*-construction, the predicate verb is usually a word or phrase that shows concrete actions. For instance, ‘zoulai (walk), fashe (launch), tu (vomit), shen (extend), pao (throw), kan (see), wang (look), and han (shout)’ etc." (p.177)

In conclusion, the following features are observed in *dui*-construction that signifies the direction.

(92) a. the object that follows *dui* is a noun that shows directions or locations.
   b. the predicate verb usually shows concrete actions.

For example,

(93)  
\[ \text{Dui } \text{fangmenkou zoulai.} \]
\[ \text{Dui } \text{doorway } \text{walk} \]

‘Walk toward the doorway.’

1.4.2 *Dui* that signifies objects and targets

Following Fu et al. (1997) and Hou (1998), the classification of *dui* that signifies objects and targets can be classified into three sub-types. The predicate verb usually shows concrete action.

(94) a. the noun following *dui* is the object of the predicate verb
   i) noun can be reconstructed after the predicate verb
   ii) noun can not be reconstructed after the predicate verb
   b. the noun following *dui* is not the object of the predicate verb
   c. the noun following *dui* is not the object of the predicate verb, but is the target of the object of the predicate verb

For example,

(95)  
\[ (94a, i) \]
\[ a. \text{Ta } \text{dui nage qianbihe } \text{kanle yiyan.} \]
\[ \text{He } \text{dui that } \text{pencil case see ASP glimpse} \]

‘He glimpsed at that pencil case.’

\[ (94a, ii) \]
\[ b. \text{Ta } \text{kanle nage qianbihe } \text{yiyan.} \]
\[ (94a, ii) \]
\[ a. \text{Ta } \text{dui nage qianbihe } \text{kanqu.} \]
\[ \text{He } \text{Dui tha pencil case see} \]

‘He looked to the direction of that pencil case.’

\[ (94b) \]
\[ b. *\text{Ta } \text{kanqu nage qianbihe.} \]

\[ (94b) \]
\[ a. \text{Ta } \text{dejia xiaole xiao.} \]
\[ \text{He } \text{dui everybody smile} \]

‘He smiled to everybody.’

(98)
1.4.3 *Dui* that signifies the action relation

There are two kinds of predicates, namely adjective predicates and verb predicates, when the *dui*-construction signifies the action relation. As for the adjective predicate, there are a lot of adjectives to express the attitude or character of a person. For instance, *hao* (good), *bucuo* (wonderful), *yange* (harsh), *qinre* (ardent), *lengdan* (cold), *zhishuang* (frank), *zhongcheng* (faithful) etc. Below shows some concrete examples.

(99) Zhangsan dui Lisi henhao.
    Zhangsan dui Lisi good

‘Zhangsan takes a friendly attitude to Lisi.’

As for the verb predicate, action verbs, dummy verbs, stative verbs, and the copula verb are often used. As for action verbs, Fu *et al.* (1997) explains, “the action verb does not show concrete actions, the meaning is always biased to the corresponding abstraction (p.177).” Typical action verbs are *yaoqiu* (demand), *huaiyi* (doubt), *manyi* (satisfy), *liaojie* (consent), *jiaoyu* (educate), *guanli* (manage), *xihuan* (like), and *zunzhong* (respect) etc.

Regarding dummy verbs, Li (1990) says, “the dummy verb does not have an actual meaning itself, it is a verb that takes gerunds as its object. There are three major dummy verbs, *jinxing* (advance), *jiayi* (put), and *zuo* (do) (p.105).

About stative verbs, Huang (1983) says, “the substantive verb shows existence, change and disappearance. For instance, ‘cunzai’ (exist), *fasheng* (generate), *you* (have), *yanbian* (change), *fazhan* (develop), *shengzhang* (grow up), *siwang* (die), *xiaoshi* (disappear), etc.” (p.315).

About the copula verb, Huang (1983) explain, “it is ‘shi’ (be) that express the judgment” (p.315).

The relation between nouns that follow *dui* and the verb predicate can be divided into the following three types.

(100) a. the noun following *dui* is the object of the predicate verb
    b. the noun following *dui* is not the object of the predicate verb
    c. the noun following *dui* is not the object of the predicate verb, but is the object of the
       object of the predicate verb

For instance,

(101) a. Zhangsan dui Lisi shufen darxin (action verb).
    Zhangsan dui Lisi very much worry

    ‘Zhangsan worries about Lisi very much.’

b. Zhangsan shufen darxin Lisi. ((100a))

(102) a. Ta dui wo tanba (the action verb) le.
    He dui me confess ASP

    ‘He confessed to me.’
b. *Ta tanbai wo le. ((100b))

(103) a. Ta dui zhejianshi zuo (dummy verb) diaocha.
    He dui this matter do investigation
    ‘He makes an investigation of this matter.’

b. Ta diaocha zhejianshi. ((100c))

(104) Mama de hua dui wo hen you (stative verb) bangzhu.
    Mom talk dui me very much have help
    ‘Mama’s talk helps me a lot.’

(105) Ta dui zhejianshi shi (the judgment verb) shenme taidu?
    He dui this matter be what attitude
    ‘What is his attitude to this thing?’

1.4.4 Dui that signifies the related relation

In the dui-construction that signifies the related relation, especially, the pattern “dui...laishuo (for)” is commonly used. For example,

(106) Jiejue zhege wenti dui ta laishuo shi bukenengde.
    Settle this problem dui him laishuo be no-possible
    ‘To settle this problem isn’t possible for him.’

1.4.5 Summary

In this section, I have introduced the classification of the meaning of dui. When dui signifies the direction, the noun following dui is always denotes a directions or locations, and the predicate verbs usually show concrete actions. When dui is used to bring out the object or the target, the predicate verbs also usually show concrete operation. When dui shows the meaning of action relation, the adjective in the adjective predicate expresses the nature or character of or towards a person, the predicate verbs are action verbs, dummy verbs, stative verbs, or the copula verbs. When dui shows the meaning of related relation, the pattern “dui...laishuo (for)” is commonly used.

The dui-construction used in the experiment is the dui that shows the action relation, and the predicate verb is always an action verb.

1.5 Why use the Dui-construction?

As discussed above, it is necessary to construct sentences with two fillers that appear in front of the verb. Because Chinese has a canonical SOV order, a preposition is needed to shuffle the order of the constituents. With a fronted prepositional phrase, it is possible to construct a sentence with an SOV order. In a word, the construction with the order “Subject - pre-Object - Verb 1 - [S PRO verb 2]” is made possible by using a preposition.

To verify the MRF strategy, we need constructions that allow the prepositional object phrase to be placed at the beginning of a sentence. Prepositions such as cong (from), dao (to), dui (toward), gei (for/to), gen (with), and zai (at) +NP are some possible candidates. The structure “Pre-Object - Subject - trace - Verb 1 - [S PRO verb 2]” is legitimate in constructions with these prepositions. However, only the proposition dui can co-occur with control verbs. Only by using the preposition dui can both “Subject - pre-Object - Verb 1 (control verb) - [S PRO verb 2]” and “Pre-Object - Subject - trace - Verb 1 (control verb) - [S PRO verb 2]” constructions be made possible. The dui-construction used here is the dui that shows the action relation, and the predicate verb is always an action verb.
Appendix B: Verb Acquisition (Ch.2)
(* = S-control verbs used in the on-line experiment, ^ = O-control verbs used in the on-line experiment)

<table>
<thead>
<tr>
<th>^1 命令 mìnglìng (order)</th>
<th>^2 吹牛 chuīniu (brag)</th>
<th>^3 保证 bǎozhèng (guarantee)</th>
</tr>
</thead>
<tbody>
<tr>
<td>请示 qǐngshì (offer)</td>
<td>^5 坦白 tānbái (confess)</td>
<td>^6 炫耀 xuànyào (proud)</td>
</tr>
<tr>
<td>^7 劝告 quanguà (advise)</td>
<td>^8 劝勉 quànmǎn (encourage)</td>
<td>^9 表明 biǎomíng (express)</td>
</tr>
<tr>
<td>^10 建议 jiànyì (suggest)</td>
<td>^11 发誓 fāshì (swear)</td>
<td>^12 汇报 huìbào (report)</td>
</tr>
<tr>
<td>^13 要求 yàqu (demand)</td>
<td>^14 激励 jīlì (encourage)</td>
<td>^15 夸耀 kuàyào (brag)</td>
</tr>
<tr>
<td>^16 卖弄 mànnòng (pride)</td>
<td>^17 祝福 zhùfú (bless)</td>
<td>^18 许诺 xǔnuò (consent)</td>
</tr>
<tr>
<td>^19 吐露 tǔlù (expose)</td>
<td>^20 嘱咐 zhǔfù (persuade)</td>
<td>^21 解释 jiěshì (interpret)</td>
</tr>
<tr>
<td>^22 祝愿 zhùyuàn (congratulate)</td>
<td>^23 劝导 quándào (advise)</td>
<td>^24 吹嘘 chuīxū (proud)</td>
</tr>
<tr>
<td>^25 承诺 chéngnuò (promise)</td>
<td>^26 提醒 tíxǐng (attention)</td>
<td>^27 恭喜 gōngxǐ (privacy)</td>
</tr>
<tr>
<td>^28 表态 biǎotài (express)</td>
<td>^29 鼓励 gǔlì (encourage)</td>
<td>^30 称赞 chēngzan (praise)</td>
</tr>
<tr>
<td>^31 指使 zhǐshǐ (order)</td>
<td>^32 承认 chéngrén (approve)</td>
<td>^33 吹嘘 chuīxù (proud)</td>
</tr>
<tr>
<td>^34 开导 kāidǎo (conduct)</td>
<td>^35 辩解 biànjiě (excuse)</td>
<td>^36 佩服 péifu (admire)</td>
</tr>
</tbody>
</table>

Appendix C: Chinese Sentences for Experiment (Ch.2)
(SC: subject control; OC: object control; SCS: subject control (scrambling); OCS: object control (scrambling); SF: subject filler sentence; OF: object filler sentence)

Practice
1 OSC 对东东 丹丹 煽动说 放学之后看冰灯。
2 SF 明明 为了 让莹莹 高兴 每天 学英语。
3 SC 亮亮 对丽丽 吐露说 天天晚上弹吉他。
4 OF 丹丹 强行 让东东 放学之后 扫走廊。
5 OC 丽丽 对亮亮 鼓动说 今天晚上学电脑。
6 SF 明明 为了 让莹莹 生气 放学打篮球。
7 SCS 对丹丹 东东 表白说 天天晚上下跳棋。
8 SF 莹莹 为了 让亮亮 为难 天天玩游戏。

Warm-up
1 SCS 对东东 丹丹 告白说 天天晚上练芭蕾。
2 OF 亮亮 强行 让丽丽 今天晚上说英语。
3 OC 莹莹 对明明 夸奖说 数学考试得高分。
4 SCS 亮亮 对丽丽 申请说 明天早上做体操。
5 SF 明明 为了 让莹莹 生气 天天读小说。
6 OCS 对丹丹 东东 诱导说 今天晚上看电影。

SF
1 SF 东东 为了 让丹丹 高兴 认真做作业。
2 SF 亮亮 为了 让丽丽 安心 晚上 学电脑。
3 SF 明明 为了 让莹莹 生气 放学 打篮球。
4 SF 丹丹 为了 让东东 高兴 下课 扫教室。
5 SF 丽丽 为了 让亮亮 生气 晚上 跳芭蕾。
6 SF 莹莹 为了 让明明 安心 坚持 读英语。
7 SF 东东 为了 让丹丹 生气 每天 下跳棋。
为了让亮亮高兴，下课擦黑板。
为了让丽丽高兴，放学写板报。
为了让东东安心，考试拿第一。
为了让丽丽生气，天天玩象棋。
东东强行让丹丹明天认真考数学。
明明强行让莹莹今天在家洗衣服。
亮亮强行让丽丽明天一定背课文。
明明强行让莹莹每天按时交作业。
丽丽强行让亮亮今年春节放鞭炮。
丹丹强行让东东明天早上念课文。
莹莹强行让明明每天下课听广播。
东东对丹丹发誓说今天认真做作业。
25 OCS 对东东 丹丹 佩服说 每天 晚上 拉二胡。
26 OCS 对亮亮 丽丽 开导说 今天 下课 听广播。
27 OCS 对莹莹 明明 建议说 每天 下课 画素描。
28 OCS 对丹丹 东东 劝导说 每天 一定 吃青菜。

List 2
1 SC 丽丽 对亮亮 许诺说 每天 下课 擦黑板。
2 SC 明明 对莹莹 卖弄说 今天 考试 拿第一。
3 SC 东东 对丹丹 吹牛说 每天 放学 下围棋。
4 SC 丽丽 对亮亮 夸耀说 天天 早上 唱京剧。
5 SC 莹莹 对明明 承诺说 天天 晚上 用电脑。
6 SC 东东 对丹丹 吐露说 天天 放学 玩象棋。
7 SC 亮亮 对丽丽 保证说 天天 早上 喝牛奶。
8 OC 明明 对莹莹 嘱咐说 明天 认真 考数学。
9 SC 丹丹 对东东 鼓励说 每天 在家 洗衣服。
10 OC 丽丽 对亮亮 命令说 明天 一定 背课文。
11 OC 明明 对莹莹 勉励说 每天 晚上 看新闻。
12 OC 东东 对丹丹 劝告说 每天 在家 干家务。
13 OC 丽丽 对亮亮 敦促说 天天 晚上 练钢琴。
14 OC 莹莹 对明明 吹牛说 明天 早上 念课文。
15 SCS 对丹丹 东东 许诺说 天天 放学 弹钢琴。
16 SCS 对丽丽 亮亮 卖弄说 数学 竞赛 获名次。
17 SCS 对莹莹 明明 吹牛说 每天 按时 交作业。
18 SCS 对东东 丹丹 夸耀说 每天 晚上 拉二胡。
19 SCS 对亮亮 丽丽 承诺说 今天 下课 听广播。
20 SCS 对莹莹 明明 吐露说 每天 下课 画素描。
21 SCS 对丹丹 东东 保证说 每天 一定 吃青菜。
22 OCS 对丹丹 东东 嘱咐说 今天 认真 做作业。
23 OCS 对丽丽 亮亮 劝告说 天天 晚上 学电脑。
24 OCS 对明明 莹莹 命令说 今天 放学 扫教室。
25 OCS 对丹丹 东东 勉励说 天天 放学 打篮球。
26 OCS 对丽丽 亮亮 劝告说 每天 晚上 跳芭蕾。
27 OCS 对莹莹 明明 敦促说 每天 坚持 读英语。
28 OCS 对东东 丹丹 嘱咐说 今天 放学 写板报。

List 3
1 SC 明明 对莹莹 发誓说 明天 认真 考数学。
2 SC 丹丹 对东东 吹嘘说 每天 在家 洗衣服。
3 SC 丽丽 对亮亮 表态说 明天 一定 背课文。
4 SC 明明 对莹莹 承认说 每天 晚上 看新闻。
5 SC 东东 对丹丹 炫耀说 每天 在家 干家务。
6 SC 丽丽 对亮亮 坦白说 天天 晚上 练钢琴。
7 SC 莹莹 对明明 汇报说 明天 早上 念课文。
8 OC 东东 对丹丹 要求说 天天 放学 弹钢琴。
9 OC 亮亮 对丽丽 祝愿说 数学 竞赛 获名次。
10 OC 明明 对莹莹 称赞说 每天 按时 交作业。
11 OC 丹丹 对东东 佩服说 每天 晚上 拉二胡。
12 OC 丽丽 对亮亮 开导说 今天 下课 听广播。
13 OC 明明 对莹莹 建议说 每天 下课 画素描。

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14 OC 东东 对丹丹 劝导说 每天 一定 吃青菜。
15 SCS 对丹丹 东东 发誓说 今天 认真 做作业。
16 SCS 对丽丽 亮亮 吹嘘说 天天 晚上 学电脑。
17 SCS 对明明 莹莹 表态说 今天 放学 扫教室。
18 SCS 对丹丹 东东 承认说 天天 放学 打篮球。
19 SCS 对丽丽 亮亮 炫耀说 每天 晚上 跳芭蕾。
20 SCS 对莹莹 明明 坦白说 每天 坚持 读英语。
21 SCS 对东东 丹丹 汇报说 今天 放学 写板报。
22 OCS 对亮亮 丽丽 要求说 每天 下课 擦黑板。
23 OCS 对莹莹 明明 祝愿说 今天 考试 拿第一。
24 OCS 对丹丹 东东 称赞说 每天 放学 下围棋。
25 OCS 对丽丽 亮亮 佩服说 天天 早上 唱京剧。
26 OCS 对明明 莹莹 开导说 每天 晚上 用电脑。
27 OCS 对丹丹 东东 坦白说 天天 放学 玩象棋。
28 OCS 对丽丽 亮亮 劝导说 天天 早上 喝牛奶。

List 4
1 SC 东东 对丹丹 许诺说 天天 放学 弹钢琴。
2 SC 亮亮 对丽丽 卖弄说 数学 竞赛 获名次。
3 SC 明明 对莹莹 吹牛说 每天 按时 交作业。
4 SC 丹丹 对东东 夸耀说 每天 晚上 拉二胡。
5 SC 丽丽 对亮亮 承诺说 今天 下课 听广播。
6 SC 明明 对莹莹 吹嘘说 每天 下课 画素描。
7 SC 东东 对丹丹 保证说 每天 一定 吃青菜。
8 OC 东东 对丹丹 吹牛说 今天 认真 做作业。
9 OC 亮亮 对丽丽 鼓励说 天天 晚上 学电脑。
10 OC 莹莹 对明明 命令说 今天 放学 扫教室。
11 OC 东东 对丹丹 勉励说 天天 放学 打篮球。
12 OC 亮亮 对丽丽 劝告说 每天 晚上 跳芭蕾。
13 OC 明明 对莹莹 敦促说 每天 坚持 读英语。
14 OC 丹丹 对东东 告诉说 今天 放学 写板报。
15 SCS 对亮亮 丽丽 许诺说 每天 下课 擦黑板。
16 SCS 对莹莹 明明 卖弄说 今天 考试 拿第一。
17 SCS 对丹丹 东东 吹牛说 每天 放学 下围棋。
18 SCS 对亮亮 丽丽 夸耀说 天天 早上 唱京剧。
19 SCS 对明明 莹莹 承诺说 每天 晚上 用电脑。
20 SCS 对丹丹 东东 吹嘘说 天天 放学 玩象棋。
21 SCS 对丽丽 亮亮 保证说 天天 早上 喝牛奶。
22 OCS 对莹莹 明明 吹嘘说 明天 认真 考数学。
23 OCS 对东东 丹丹 勉励说 每天 在家 洗衣服。
24 OCS 对亮亮 丽丽 命令说 明天 一定 背课文。
25 OCS 对莹莹 明明 鼓励说 每天 晚上 看新闻。
26 OCS 对丹丹 东东 劝告说 每天 在家 干家务。
27 OCS 对亮亮 丽丽 敦促说 天天 晚上 练钢琴。
28 OCS 对明明 莹莹 吹嘘说 明天 早上 念课文。
Appendix D: Japanese Sentences for Experiment (Ch.3)
(SC: subject control; OC: object control; SCS: subject control (scrambling); OCS: object control (scrambling); SF: subject filler sentence; OF: object filler sentence)

Practice
1. OF あきさんが おととい ゆうじくんを 自転車で 学校に行かせた。
2. SF まりさんに おととい けんじくんが 会うために 大阪に行った。
3. SC けんじくんが きのう まりさんに 遠くへ引っ越しを おしえた。
4. SCS ひろしくんに きのう あきさんが てんこうすることを 告げた。
5. OF まりさんが きのう こうじくんを わらわせるために マンガをみせた。
6. OCS あやさんに おととい ひろしくんが さんすうを 教えることを ねだった。

Warm-up
1. SF あやさんが おととい ひろしくんを よろこばせるために チョコレートをあげた。
2. OCSあきさんに きのう こうじくんが 宿題することを お願いした。
3. SC ゆうじくんが おととい ゆみさんに 運動会を 休むことを ひみつにした。
4. OF けんじくんを きのう まりさんが 自転車で 学校に行かせた。
5. SC まりさんが きのう けんじくんに しかじゅつすることを こくはくした。
6. OF こうじくんに きのう あきさんが テストでいい点を取ることを 言わせた。

SF
1. SF まりさんが きのう けんじくんに 会うために 東京にでかけた。
2. SF あきさんが きのう こうじくんを こまらせるために 学校を休んだ。
3. SF ゆみさんが おととい ゆうじくんを よろこばせるために そうじをした。
4. SF あやさんが おととい ひろしくんを 遊ぶために 公園に行かせた。
5. SF けんじくんが きのう まりさんを おこらせるために ノートをやぶった。
6. SF ゆうじくんと きのう あきさんが はなすために メールを書いた。
7. SF ゆうじくんと おととい ゆみさんが 仲良くなるために 宿題をおしえた。
8. SF ひろしくんを おととい あやさんが わらわせるために ヘンカをおした。
9. SF まりさんと きのう けんじくんが ベンキょうするたために としょうかんに行った。
10. SF あきさんを きのう こうじくんが おろかせるために プレゼントをあげた。

OF
1. OF ゆみさんが おととい ゆうじくんを 自転車で コンビニにでかけさせた。
2. OF あやさんが おととい ひろしくんを 休ませるために じゅくを休ませた。
3. OF まりさんが きのう けんじくんに ぞうきんで そうじをさせた。
4. OF あきさんが きのう こうじくんを バスで 東京に行かせた。
5. OF ゆみさんが おととい ゆうじくんを よろこばせるために ケーキを食べさせた。
6. OF あやさんを おととい ひろしくんが わらわせるために テレビをみせた。
7. OF けんじくんを きのう まりさんが 歩いて 公園に行かせた。
8. OF こうじくんに きのう あきさんが 花の 写真ををらせた。
9. OF ゆうじくんに おととい ゆみさんが 教室で 本を読ませた。
10. OF ひろしくんに おととい あやさんが 英語で 歌を歌わせた。

List 1
1. SC けんじくんが きょうしつで まりさんに ウサギをかうことを いばった。
2. SC こうじくんが こうえんで あきさんに マンガをかすことを ちかった。
3. SC ゆうじくんが きのう ゆみさんに ぎゅにゅうにゅうをすてることを だましていた。
4. SC ひろしくくんが おととい あやさんに べんきょうかいをはじめることを 発表した。
12 SCS あやさんに おととい ひろしくんが てがみをおくることを 望んだ。
13 SCS あささんが きのう ゆうじくんが クッキーをつくることを 依頼した。
14 SCS ひろしくんに おととい あやさんが てがみをおくることを 命令した。
15 SCS あささんが おととい ひろしくんが ピアノを奏することを 強制した。
16 OC あきさんが おととい ひろしくんに てがみを求めることが 依頼した。
17 OCS ひろしくんに おととい あやさんが てがみをおくることを 望んだ。
18 OCS あささんが おととい ひろしくんが ビアノを演奏することを 強制した。
19 OCS あきさんが おととい ひろしくんに オペラを演奏することを 命令した。
20 OCS あきさんが おととい ひろしくんに オペラを演奏することを 強制した。

List 3
1 SC ゆうじくんが きのう ゆうじくんに バスケットをすることを 依頼した。
2 SC ひろしくんが おととい あささんに テニスをすることを 依頼した。
3 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
4 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
5 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
6 OC あきさんが おととい ひろしくんに テニスをすることを 要求した。
7 OC けんじくんが きょうしつで マリさんと テニスをすることを 要求した。
8 OC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
9 OC ゆうじくんが きのう ゆうじくんに クッキーをつくることを 依頼した。
10 OC あきさんが おととい ひろしくんに テニスをすることを 要求した。
11 OCS ひろしくんに おととい あささんが ベンチを求めることが 依頼した。
12 OC あきさんが おととい ひろしくんに テニスをすることを 要求した。
13 OC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
14 OC あきさんが おととい ひろしくんに テニスをすることを 要求した。
15 OC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
16 OC あきさんが おととい ひろしくんに テニスをすることを 要求した。
17 OCS ひろしくんに おととい あささんが ベンチを求めることが 依頼した。
18 OCS ひろしくんに おととい あささんが ベンチを求めることが 依頼した。
19 OCS ひろしくんに おととい あささんが ベンチを求めることが 依頼した。
20 OCS ひろしくんに おととい あささんが ベンチを求めることが 依頼した。

List 2
1 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
2 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
3 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
4 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
5 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
6 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
7 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
8 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
9 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
10 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
11 SC ゆうじくんが きのう ゆうじくんに テニスをすることを 依頼した。
12 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
13 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
14 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
15 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
16 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
17 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
18 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
19 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
20 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。

List 1
1 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
2 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
3 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
4 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
5 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
6 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
7 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
8 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
9 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
10 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
11 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
12 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
13 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
14 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
15 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
16 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
17 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
18 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
19 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
20 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。

List 0
1 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
2 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
3 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
4 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
5 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
6 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
7 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
8 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
9 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
10 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
11 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
12 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
13 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
14 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
15 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
16 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
17 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
18 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
19 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
20 SC あきさんが おととい ひろしくんに テニスをすることを 依頼した。
10 OC ひろしくんが おととい あやさんに ピアノをならうことを 指示した。
11 SCS まるさんに きょうしつで けんじくんが ウサギをかうことを いばった。
12 SCS あきさんに こうえんで こうじくんが マンガをかすこと を 許した。
13 SCS ゆみさんに きのう ゆうじくんが ぎゅうにゅうをすてることを だまっていた。
14 SCS あやさんに おととい ひろしくんが ぺんきょうかいをはじめることを 発表した。
15 SCS けんじくんに きょうしつで まるさんが 犬をかうことを じまんした。
16 OCS こうじくんに こうえんで あきさんが うんどうかいを休むことを 許した。
17 OCS ゆうじくんに きのう ゆみさんが かみひこうきをつくることを 求めた。
18 OCS ひろしくんに おととい あやさんが プレゼントをおくことを 要求した。
19 OCS まるさんに きょうしつで けんじくんが ゴミをすてるることを 依頼した。
20 OCS あきさんに こうえんで こうじくんが えいごをならうことを 指示した。

List 4

1 SC あやさんが おととい ひろしくんに おたんじょうかいをやめることを あやまった。
2 SC けんじくんが きょうしつで まるさんに ノートをかすこと を 約束した。
3 SC こうじくんが こうえんで あきさんに じゅくを休むことを 告白した。
4 SC ゆうじくんが きのう ゆみさんに クッキーをつくることを 報告した。
5 SC ひろしくんが おととい あやさんに ピアノをならうことを 談じた。
6 OC けんじくんが きょうしつで まるさんに ウサギをかうことを すすめた。
7 OC こうじくんが こうえんで あきさんに マンガをかすること を 望んだ。
8 OC ゆうじくんが きのう ゆみさんに ぎゅうにゅうをすてることを 命令した。
9 OC ひろしくんが おととい あやさんに ぺんきょうかいをはじめることを 強制した。
10 OC まるさんが きょうしつで けんじくんに 犬をかうことを たのましたが。
11 SCS こうじくんに こうえんで あきさんが うんどうかいを休むことを あやまった。
12 SCS ゆうじくんに きのう ゆみさんが かみひこうきをつくることを 約束した。
13 SCS ひろしくんに おととい あやさんが プレゼントをおくことを 告白した。
14 SCS まるさんに きょうしつで けんじくんが ゴミをすてるすることを 報告した。
15 SCS あきさんに こうえんで こうじくんが えいごをならうことを 相談した。
16 OCS ゆみさんに きのう ゆうじくんが パソコンをかすることを すすめた。
17 OCS あやさんに おととい ひろしくんが てがみをおくることを 望んだ。
18 OCS けんじくんに きょうしつで まるさんが なわとびをはじめることを 命令した。
19 OCS こうじくんに こうえんで あきさんが サッカーをやめることを 強制した。
20 OCS ゆうじくんに きのう ゆみさんが あたらしいゲームをかることを たのんだ。
Appendix E: Chinese Sentences for Experiment (Ch.4)
(SC: subject control; OC: object control; SCS: subject control (scrambling); OCS: object control (scrambling); SF: subject filler sentence; OF: object filler sentence)

Practice
1 OCS 对田中山本煽动说放学之后看冰灯。
2 SF 花子为了让太郎高兴每天学汉语。
3 SC 比尔对安娜吐露说天天晚上弹吉他。
4 OF 山本强行让田中放学之后听录音。
5 OC 太郎对花子鼓动说今天放学画画儿。
6 OF 安娜强行让比尔一定认真写汉字。
7 SCS 对田中山本表白说毕业之后留长春。
8 SF 花子为了让太郎为难天天玩游戏。

Warm-up
1 SCS 对比尔安娜告白说明年开学转班级。
2 OF 山本强行让田中今天晚上说汉语。
3 OC 太郎对花子夸奖说语音考试得高分。
4 SC 安娜对比尔申请说明天早上听广播。
5 SF 田中为了让山本生气天天读小说。
6 OCS 对花子太郎诱导说今天晚上看电影。

SF
1 SF 比尔为了让安娜高兴努力学中文。
2 SF 山本为了让田中安心考试得高分。
3 SF 太郎为了让花子生气晚上喝白酒。
4 SF 太郎为了让花子高兴下课买礼物。
5 SF 安娜为了让比尔生气晚上喝京剧。
6 SF 田中为了让山本安心坚持练书法。
7 SF 比尔为了让安娜生气每天玩扑克。
8 SF 山本为了让田中高兴认真考语音。
9 SF 花子为了让太郎高兴天天背唐诗。
10 SF 安娜为了让比尔安心考试拿第一。
11 SF 田中为了让山本生气天天玩象棋。
12 SF 花子为了让太郎安心天天说汉语。
13 SF 比尔为了让安娜生气明年换专业。
14 SF 山本为了让田中安心天天读杂志。

OF
1 OF 太郎强行让花子明天认真考语音。
2 OF 安娜强行让比尔今天在家洗衣服。
3 OF 田中强行让山本明天一定背课文。
4 OF 花子强行让太郎每天晚上看新闻。
5 OF 比尔强行让安娜天天晚上做晚饭。
6 OF 山本强行让田中天天晚上画画儿。
7 OF 太郎强行让花子明天早上念唐诗。
8 OF 安娜强行让比尔天天下课拉二胡。
9 OF 田中强行让山本演讲比赛获名次。
花子强行让太郎每天按时交作业。
比尔强行让安娜明年开学转班级。
山本强行让田中今天下课寄包裹。
太郎强行让花子每天下课听磁带。
安娜强行让比尔每天一定吃早饭。
比尔对安娜发誓说一定努力学汉语。
山本对田中吹嘘说语音考试得高分。
太郎对花子表态说毕业之后回日本。
安娜对比尔承认说每天坚持练汉字。
田中对山本炫耀说明天早上逛香山。
花子对太郎抱怨说天天晚上做晚饭。
比尔对安娜宣布说明年开学换专业。
山本对田中劝告说明天认真考文学。
太郎对花子佩服说天天坚持说中文。
安娜对比尔赞赏说每周周日唱京剧。
山本对田中祈祷说明天早上透香山。
花子对太郎宣布说下课马上寄包裹。
比尔对安娜发表说今年十月转班级。
山本对田中命令说明天下课买字典。
太郎对花子吩咐说下课马上寄包裹。
比尔对安娜要求说今年十月转班级。
山本对田中劝告说明天认真考文学。
太郎对花子吩咐说下课马上寄包裹。
安娜对比尔祝愿说天天早上吃早饭。
比尔对安娜发誓说一定努力学汉语。
山本对田中 CJQH 说明天早上透香山。
花子对太郎抱怨说天天晚上做晚饭。
比尔对安娜宣布说明年开学换专业。
山本对田中劝告说明天认真考文学。
太郎对花子佩服说天天坚持说中文。
安娜对比尔赞赏说每周周日唱京剧。
山本对田中祈祷说明天早上透香山。
花子对太郎宣布说下课马上寄包裹。
比尔对安娜发表说今年十月转班级。
山本对田中命令说明天下课买字典。
太郎对花子吩咐说下课马上寄包裹。
比尔对安娜要求说今年十月转班级。
山本对田中劝告说明天认真考文学。
太郎对花子吩咐说下课马上寄包裹。
安娜对比尔祝愿说天天早上吃早饭。
山本对田中鼓励说，每天必须洗衣服。
太郎对花子劝告说，今天开始画画儿。
对安娜比尔许诺说，每天一定看报纸。
对山本田中卖弄说，每天坚持读杂志。
对太郎花子夸耀说，今天开始查字典。
比尔安娜对山本许诺说，下课之后打电话。
对安娜花子出来说，每天晚上喝白酒。
对安娜保证说，每天早上吃早饭。
对安娜比尔嘱咐说，一定努力学汉语。
对安娜比尔祝愿说，语音考试得高分。
对田中山本抱怨说，今年五一游西藏。
对安娜劝告说，明天早上逛香山。
对安娜称赞说，每天坚持练汉字。
对安娜比尔表示说，每年十月转班级。
太郎对花子发誓说，天天认真听磁带。
安娜对比尔吹嘘说，书法比赛获名次。
山本对田中表示说，天天坚持读唐诗。
花子对太郎承认说，天天晚上拉二胡。
对安娜炫耀说，今年五一游西藏。
比尔对安娜抱怨说，每天必须洗衣服。
对安娜许诺说，今天开始画画儿。
对安娜比尔命令说，下课之后买字典。
安娜对比尔祈祷说，语音考试得高分。
对安娜祈祷说，毕业之后回日本。
比尔对安娜赞叹说，天天坚持练汉字。
对安娜比尔宣布说，明年开学换专业。
对安娜比尔劝告说，明天认真考文学。
安娜对山本许诺说，每天坚持说中文。
对安娜祈祷说，每天认真考文学。
List 4
1 SC 安娜对比尔许诺说每天一定看报纸。
2 SC 田中对山本卖弄说每天坚持读杂志。
3 SC 比尔对安娜吹牛说天天坚持写汉字。
4 SC 花子对太郎夸耀说每天坚持查字典。
5 SC 山本对田中承诺说下课之后打电话。
6 SC 太郎对花子吐露说每天晚上喝白酒。
7 SC 安娜对比尔保证说天天早上吃早饭。
8 OC 比尔对安娜嘱咐说一定努力学汉语。
9 OC 山本对田中祝愿说语音考试得高分。
10 OC 太郎对花子期待说毕业之后回日本。
11 OC 安娜对比尔称赞说每天坚持练汉字。
12 OC 田中对山本建议说明天早上逛香山。
13 OC 花子对太郎鼓励说天天晚上做晚饭。
14 OC 比尔对安娜劝导说明年开学换专业。
15 SCS 对田中山本许诺说明天认真考文学。
16 SCS 对花子太郎卖弄说天天坚持说中文。
17 SCS 对比尔安娜吹牛说每周周日唱京剧。
18 SCS 对山本田中夸耀说演讲比赛拿第一。
19 SCS 对太郎花子承诺说下课马上寄包裹。
20 SCS 对安娜比尔吐露说今年十月转班级。
21 SCS 对田中山本保证说今天下课买字典。
22 OCS 对花子太郎嘱咐说天天认真听磁带。
23 OCS 对比尔安娜祝愿说书法比赛获名次。
24 OCS 对山本田中期待说天天坚持背唐诗。
25 OCS 对太郎花子称赞说天天晚上拉二胡。
26 OCS 对安娜比尔建议说今年五一游西藏。
27 OCS 对田中山本鼓励说每天必须洗衣服。
28 OCS 对花子太郎劝导说今天开始画画儿。
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