Processing Subject Control Sentences among L1 English/L2 Chinese Learners

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Abstract

Based on an empty subject processing experiment conducted on Chinese children, the "Developmental Shift of Parsing Strategies (DSPS)" hypothesis was proposed, which states that the choice of parsing strategies is parallel to language development. Second language learners, unlike grade-schoolers, are well-developed in their cognitive ability. In this case, it is interesting to know whether non-linguistic strategies will be used when the L2 learners process sentences including verbs not yet acquired. If the DSPS hypothesis is a universal hypothesis, despite having higher cognitive abilities, L2 learners of lower proficiency will tend to use non-linguistic strategies, just like a child who is acquiring their first language; while those with higher proficiency will tend to employ more linguistic strategies in comprehension. In order to clarify the process of "developmental shift", an experiment from the perspective of English native speakers learning Chinese was conducted. The results show that non-linguistic strategies were used at an earlier stage, followed by a mixture of non-linguistic strategy and linguistic strategy at an intermediate stage, and linguistic strategy based on verb information at the later stage of L2 learning. This result supports the DSPS hypothesis.

Key terms: empty subject processing, general-purpose strategy, linguistic strategy, Developmental Shift of Parsing Strategies

1. Introduction

Zhai (2012) clarified the empty subject sentence processing of elementary school students in China. The first-grader participants in the elementary school, who had not acquired the matrix verbs and had relatively low cognitive ability, preferred using 'recency strategy' (the nearest filler, Zhai, 2012, pp. 99-100) to fill the empty subject. That is, perceptual strategy (i.e., non-linguistic strategy) was utilized at the earlier stage of language development. Both linguistic strategy and perceptual strategy were utilized in a mixed way in second, third, and fourth grader participants whose linguistic and cognitive ability were more advanced than first-grader participants. The fifth-grader participants used the control information on the verb to process the sentence. Thus, this shows that verb control information (linguistic strategy) becomes available at a later stage of language development. Zhai (2012) claimed that parsing strategies shift from perceptual strategy to linguistic strategy along with the development of linguistic knowledge, and referred to this proposal as the 'Developmental Shift of Parsing Strategies (DSPS)' hypothesis (Zhai, 2012, p. 104).

From an empty subject sentences processing experiment conducted on Chinese children (Zhai, 2012), the process at the different levels of verb acquisition was clarified, and the DSPS hypothesis was proposed. Lower grade children, due to their relatively low cognitive ability, prefer using non-linguistic strategies 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 present study 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 non-linguistic strategies will be used when the L2 learners process sentences including matrix verbs not yet acquired. What causes the use of non-linguistic 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 their first language, while those with higher proficiency will tend to employ more linguistic strategy in comprehension.

In section 2, I will introduce a test concerned with empty subject sentences processing among Chinese children. In section 3, 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, I discuss the applicability of the DSPS hypothesis to L2 learners.

2. Processing empty subject sentences among Chinese children

Zhai (2012) used the following empty subject sentences 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.

(1) a. SOV order, Subject Control sentence

亮亮$_1$ / 对 丽丽$_2$ / 发誓 说/ [今天 / 认真 / PRO$_1$ 做 作业]。
Liangliang to Lili swear that today seriously do homework

'Liangliang swore to Lili that today he would do his homework seriously.'

b. SOV order, Object Control sentence

亮亮$_1$ / 对 丽丽$_2$ / 嘱咐 说 / [今天 / 认真 / PRO$_2$ 做 作业]。
Liangliang to Lili persuade that today seriously do homework

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

c. OSV order, Subject control sentence

对 丽丽$_2$ / 亮亮$_1$ / 发誓 说 / [今天 / 认真 / PRO$_1$ 做 作业]。
to Lili Liangliang swear that today seriously do homework

'Liangliang swore to Lili that today he will do his homework seriously.'

d. OSV order, Object Control sentence

对 丽丽$_2$ / 亮亮$_1$ / 嘱咐 说 / [今天 / 认真 / PRO$_2$ 做 作业]。
to Lili Liangliang persuade that today seriously do homework

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

Twenty-eight pairs of experimental sentences like (1), each consisting of four conditions (SOV order vs. OSV order; subject control vs. object control) were constructed, which made a total of one hundred twelve sentences. Sixty participants (twelve participants in each grade) participated in this experiment. 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. One phrase was displayed at a time.

The results show that first graders in the elementary school who have not acquired the meaning of matrix verbs and have relatively low 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 strategy (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, it is worth pointing out the possibility that with the increase in memory capacity, the effect of primacy may have become more pronounced.

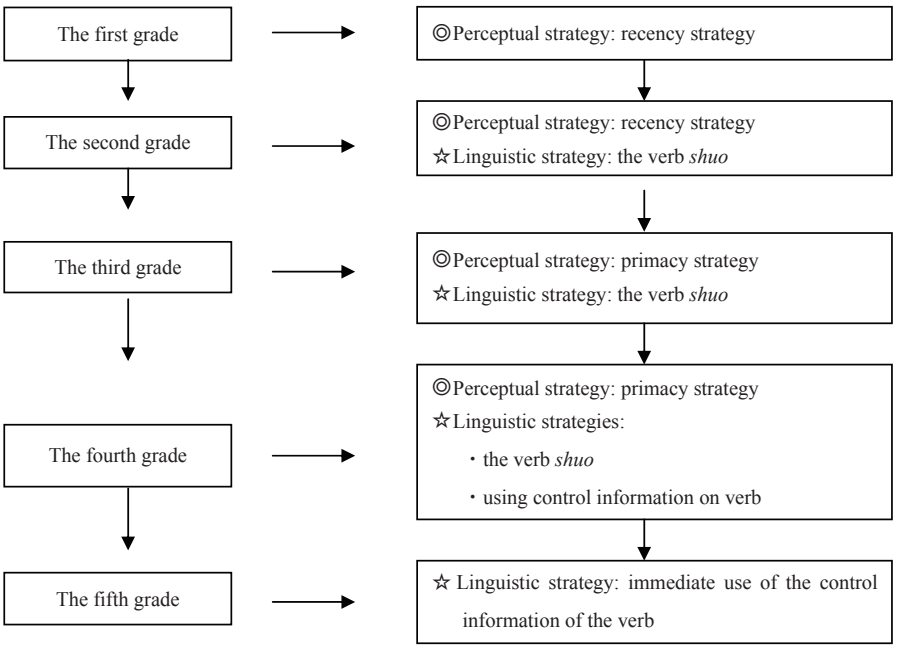
The fourth graders acquired more matrix verbs than the third graders, and parsing has also become more complex. It

seemed that both linguistic strategy (i.e., 'the verb *shuo*', and the use of control information on the 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 1: The results of L1 Chinese



The "Developmental Shift of Parsing Strategies (DSPS)" hypothesis was proposed, as stated in (2).

(2) Developmental Shift of Parsing Strategies hypothesis:
The parsing strategies shift from "Perceptual strategy" to "Linguistic strategy" along with the development of linguistic knowledge.

3. Processing Chinese empty subject sentences among L1 English / L2 Chinese learners

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

3.1 Experimental Design

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

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 (Deng, 2004; Chen, 2006; Liu & Liu, 1999) 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.

(3) a. SOV order, Subject control sentence

P1 P2 P3 P4 P5 P6

比尔$_1$ / 对 安娜$_2$ / 发誓 说 / [一定 / 努力 / PRO_1 学 汉语]。

Bill to Anna swear that certainly hard study Chinese

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

[Question sentence] 比尔 一定 努力 学 汉语。

Bill certainly hard study Chinese

'Bill will certainly study Chinese hard.'

b. SOV order, Object control sentence

比尔$_1$ / 对 安娜$_2$ / 嘱咐 说 / [一定 / 努力 / PRO_2 学 汉语]。

Bill to Anna 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 certainly hard study Chinese

'Anna will certainly study Chinese hard.'

c. OSV order, Subject control sentence

对 安娜$_2$ / 比尔$_1$ / 发誓 说 / [一定 / 努力 / PRO_1 学 汉语]。

To Anna Bill swear that certainly hard study Chinese

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

[Question sentence] 比尔 一定 努力 学 汉语。

Bill certainly hard study Chinese

'Bill will certainly study Chinese hard.'

d. OSV order, Object control sentence

对 安娜$_2$ / 比尔$_1$ / 嘱咐 说 / [一定 / 努力 / PRO_2 学 汉语]。

To Anna Bill 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 certainly hard study Chinese

'Anna will certainly study Chinese hard.'

The matrix verb *fashi* 'swear' in (3a, c) is a subject control verb, whereas the matrix verb *zhufu* 'persuade' in (3b, d) is an object control verb. (3a, b) took the 'subject – object' word order, and (3c, d) the 'object – subject' word order. Thus, the experiment design was 2 (verb types) × 2 (word orders).

Twenty-eight pairs of experimental sentences like (3), each consisting 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. These sentences were presented in a random order.

3.2 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 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 sentence was chunked into phrases. One phrase was displayed at a 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 shift rightward, so that the previous chunk would disappear from the screen and the next chunk would appear. 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. 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 possibility 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, a 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 1).

Table 1: Number of acquired verbs (AV) and verbs not acquired (UV)

	Beginner level		*Intermediate level*		*Advanced level*	
	AV	UV	AV	UV	AV	UV
Subject control verb	0	70	23	47	48	22
Object control verb	1	69	31	39	59	11
Total	1	139	54	86	107	33

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 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).

3.3 Prediction

Verbs not acquired

As shown in Table 1, it is clear that the beginners had hardly acquired any matrix verbs, so they were 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.

Various possible explanations 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 encounter unknown words. If "distance" information (a cognitive heuristics) 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 study Chinese hard.*" would also be expected, because NP1 (*Bill*) is a distant filler from PRO.

In the OSV word order, 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 study Chinese hard.*" would increase, because NP2 (*Anna*) is a distant filler from PRO in the OSV word order.

ii): Perceptual strategy – primacy strategy

If "position" information (another cognitive heuristics) 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 study 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.

In the OSV word order, 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 study Chinese hard.*" would increase. As an indirect and secondary indication, the NO responses for "*Bill will certainly study Chinese hard.*" would also increase.

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*, I expected the number of YES responses for "*Bill will certainly study 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 study 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 study Chinese hard.*" than the question "*Anna will certainly study Chinese hard.*", since the preposition *dui* do not appear before NP1.

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 of the control information of the experimental verbs. I assumed that the correct answer rate would be higher for sentences containing an acquired verb. Naturally, participants are expected to utilize "Linguistic strategy" 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), 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 differences 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 those of object control verbs.

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?

3.4 Results and discussion

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 it?

The results of beginner level learners for the SOV and OSV word order are shown below. The statistics were taken using Fisher's exact test. This was done since Fisher's exact test is useful for categorical data that result from classing objects in two different ways, and it is used to examine the significance of the association between the two kinds of classification.

Table 2: Questions and YES/NO responses by beginners on verbs not acquired in SOV and OSV order

SOV	*YES*	*NO*	*total*
NP1 (distant filler)	47 (67%)	23 (33%)	70
NP2 (recent filler)	38 (55%)	31 (45%)	84
total	85	54	139

(Fisher's exact test: n.s.)

OSV	*YES*	*NO*	*total*
NP1 (recent filler)	49 (70%)	21 (30%)	70
NP2 (distant filler)	48 (70%)	21 (30%)	69
total	97	42	139

(Fisher's exact test: n.s.)

There is no significant difference between the YES/NO responses and sentence question type (Fisher's exact test, n=139, p=.1659) in SOV word order, and (Fisher's exact test, n=139, p=0.9999) in OSV word order, as shown in Table 2. From this result, it seems that beginners did not employ any strategies to "guess" the sentences. However, because 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. 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 strategy" (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.

i) perceptual strategy: recency strategy + perceptual strategy: primacy strategy
ii) linguistic strategy: the preposition *dui* + linguistic strategy: the verb *shuo*

Intermediate level

The results of intermediate level learners are shown below.

Table 3: Questions and YES/NO responses by intermediate level learners on verbs not acquired in SOV and OSV order

SOV	*YES*	*NO*	*total*
NP1 (distant filler)	28 (60%)	19 (40%)	47
NP2 (recent filler)	7 (18%)	32 (82%)	39
total	35	51	86

(Fisher's exact test: $p<.05$)

OSV	*YES*	*NO*	*total*
NP1 (recent filler)	19 (40%)	28 (60%)	47
NP2 (distant filler)	16 (41%)	23 (59%)	39
total	35	51	86

(Fisher's exact test: n.s.)

Table 3 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 SOV word order, and there is no difference between the responses for the sentence question types (Fisher's exact test, n=86, $p=0.9999$) in OSV word order. 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. However, a clear difference between the YES/NO responses was seen in the SOV word order object control sentence questions. Therefore, I conclude that the intermediate level learners would employ some strategies to "guess" the sentences with verbs not yet acquired.

The higher ratio of YES responses for NP1 was shown in the SOV word order, whereas there is competition between NP1 preference and NP2 preference in the OSV word order. The use 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 was 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 as if 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.

i) perceptual strategy: primacy strategy
ii) linguistic strategy: the verb *shuo*

Now, I will discuss the problem that remained for the beginners: whether beginners can use two "Linguistic strategy" 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, the two possibilities, i) and ii) about beginners, were mutually exclusive. Possibility i) is the combination of two "Perceptual strategies", whereas ii) is the combination of two "Linguistic strategy". 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.

Advanced level

The results of advanced level learners are shown below.

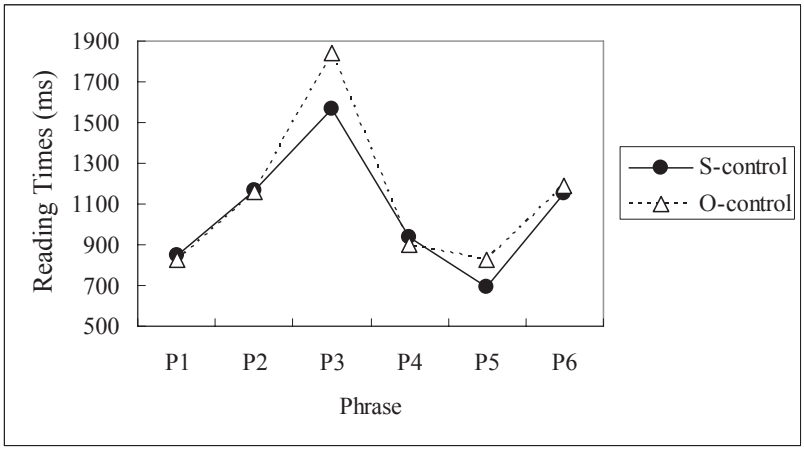


Figure 1: RTs of each phrase for acquired verbs in SOV order at advanced level

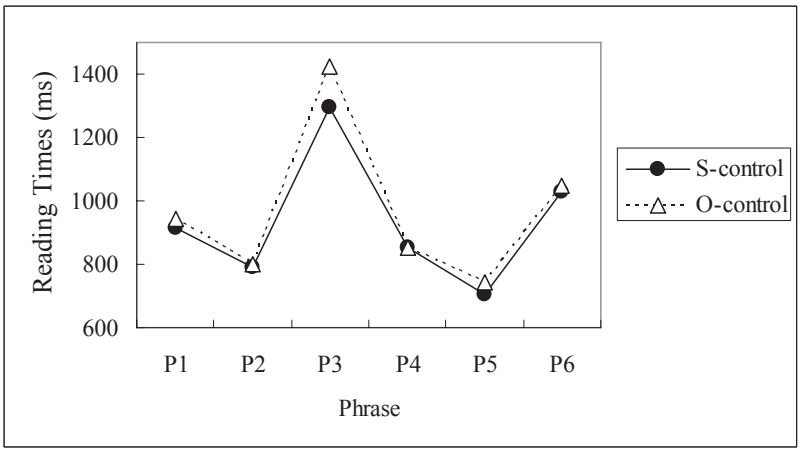


Figure 2: RTs of each phrase for acquired verbs in OSV order at advanced level

Figure 1 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 = 1564ms; object control sentence: M = 1842ms, $t_{(9)} = 3.782$, $p < .05$). On the other hand, in the RTs of the complement clause verb P6, a significant difference is not observed (subject control sentence: M = 1154ms; object control sentence: M = 1187ms, $t_{(9)} = .362$, $p = .726$).

Figure 2 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 = 1294ms; object control sentence: M = 1426ms, $t_{(9)} = 1.349$, $p = .21$ n.s.). In the RTs of

the complement clause verb P6, a significant difference is also not observed (subject control sentence: M = 1029ms; object control sentence: M = 1048ms, $t_{(9)}$ = .892, p = .396).

When the advanced level participants read the sentences with acquired verbs, Figure 1 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 2 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 those 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. So, we can conclude that L2 learners made use of linguistic strategy based on verb control information at a later stage of learning.

4. Concluding remarks

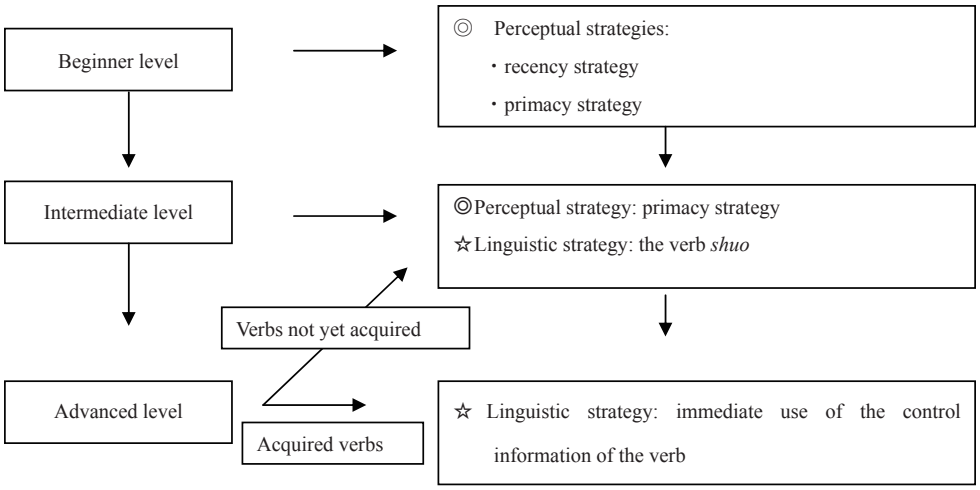
From the results of the SOV word order and OSV word order, it is clear that beginners who had not acquired the meaning of matrix verbs preferred using the 'recency strategy' and 'primacy strategy' to fill the empty subject. That is, non-linguistic and general-purpose strategies were utilized at the earlier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

Graph 2: The results of L2 Chinese



Now, I will answer the questions set forth at the beginning of this study.

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

From Graph 2, "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 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 study, the influence of first language was not observed.

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 supports the DSPS hypothesis.

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