

Speed of Chinese Sentence Comprehension of the Foreign Students at Secondary Level

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ABSTRACT. A key index to the learners' proficiency level of a second language, the comprehension speed of sentence is a pivotal factor that determines the choice of teaching method which may suit the second language learners in their learning of specialty courses. According to the representation of inner knowledge of second language and the character of its processing, some researchers described a quickening tendency of second language process speed during the acquisition of the language. With respect to the reason why the change of process speed occurs, however, the researchers did not explain it from the difference between learner's mother tongue and the second language, which may be important in practice. This study explored the speed of Chinese sentence comprehension of foreign students whose Chinese knowledge was at the secondary level. In the experiment, there were four groups of subjects, twenty in each and all paid for their participation. Three groups are native English, Japanese and Korean speakers, and the other group is Mandarin Chinese speakers selected as comparison. Ten constructions of Chinese sentences were chosen as the test materials, including three subject-verb-object constructions (zhu dong bin ju), subject-verb-agent construction (shi bin ju), two topic-comment constructions, two Ba constructions, Bei construction, and BeiBa compound construction. The six native Mandarin Chinese speakers, who did not actually participate in the experiment, scored all the sentences in the experiment in terms of grammaticality. All the sentences were presented one by one at random on the screen of a Pentium IV laptop, each followed by three possible answers about the actor of the action described in the sentence. The subjects should choose one answer among the three as accurately and quickly as possible by pressing a certain key on the keyboard. There were some sentences for pretest before the formal experiment, and reaction time and chosen answer for each sentence were self-recorded. The post hoc multiple comparison tests were performed for the reaction time of each construction of Chinese sentences separately. SPSS analysis showed that: (1) there was a highly

significant difference ($p < 0.001$) between all the groups of the foreign students and the native Chinese speakers in the comprehension of ten constructions of Chinese sentences except one of the topic-comment constructions (zhu ling ju) ($p = 0.018$). (2) there was a significant difference ($p < 0.05$) between the students of the native English speakers and the students of the native Japanese or Korean speakers in comprehending seven of the ten constructions of Chinese sentences. The research found highly significant difference between the foreign students and the Mandarin Chinese speakers in Chinese sentence comprehension, even though the former's Chinese knowledge was at the secondary level. The foreign students' comprehension speed of Chinese sentences was also related to their specific mother tongue, significant difference being found between the students whose mother tongue is English and those whose mother tongues are Japanese and Korean, though the difference was less significant with foreign learners of Chinese at the primary level. The differences between the learners' native languages and Chinese in character type also had an effect on the result. The findings of our experiment provided some implications for the teaching of Chinese language to the foreign students according to their specific native language.

Key words: second language acquisition; Chinese sentence; comprehension speed

1. Introduction. Since the 1980s, researchers have put forward various viewpoints regarding the processing speed of second language. Anderson divided knowledge in memory into knowledge representations of two automatic levels: declarative knowledge and procedural knowledge. The former had a low automatic level and processing speed, while those of the latter were high. He also believed that second language acquisition is a process during which declarative knowledge transfers into procedural knowledge, and repetitive exercises contribute to the realization of this transfer. During the acquisition process, although some learners acquired higher-level procedural knowledge through exercises, Anderson held the view that they haven't completely reached the automatic stage, his view see [1] in the references section at the end of this article. Mclanghlin distinguished control processing and automatic processing of second language, believing that at the early stages of second language acquisition learners adopt control processing, and then with continuous exercises control processing transfers into automatic processing, his view can be found [2] in the references section. The above-mentioned studies described the tendency of language processing speed during acquisition from the points of the inner knowledge representation of second language as well as its processing features, but they failed to give explanations for the change of the processing speed from the angles of the relations between the two languages and their characters.

Sentences are important units of language and its use, and major embodiments of grammatical rules, therefore the study of sentences has long been broadly attended to by both psychology and linguistics, and occupies a significant position in language acquisition. Comprehension and production are the two basic aspects of sentence use in communication, and comprehension aroused broad interests of the researchers. Psychology has carried out

explorations on sentence comprehension, and come up with some valuable theories. The Theory of Structure Building Framework believed that to comprehend a language a coherent psychological structure or representation needs to be built up, including three processes of founding, mapping and shifting. At the beginning, comprehenders make use of the initial input and build a basic structure; then when the newly input information is consistent with the basic structure, it shall be mapped to this structure and cause it to continuously develop; but if the new information doesn't suit the structure being built, a shift shall be needed to build a new structure. The construction materials of psychological structure are memory units (such as words and their structural relations, etc.), which are activated by input stimuli, and controlled by the cognitive mechanisms of suppression and enhancement. Suppression means actively inhibiting the activations of the memory units irrelevant to the structure, including two aspects of automatic processing and control processing. While enhancement is to strengthen the activations of the memory units related to the structure, his view see [4] in the references section. Activation and inhibition are the two basic processes of language processing that supplement each other. Relevant domestic studies carried out explorations on Chinese sentence comprehension from the points of activation and inhibition, with the native Chinese-speakers as subjects. For more results on this topic, we refer readers to [4-6] and the references therein. With the incessant upsurge of Chinese learning both domestically and overseas, as well as the country's strategy to spread Chinese internationally, it bears significant practical application to explore the rules of Chinese sentence comprehension in the foreign students.

The study of Chinese sentence comprehension by the foreigners dated back to those with the native English-speakers as subjects. The study found that the subjects depended on both word order and semantics, but more on word order to comprehend Chinese sentences. For more results of the study, see [7] in the references. In the field of acquisition of Chinese as second language, the index of accuracy rate was usually used to study how the foreign students process Chinese words and characters, and in several cases the index of reaction time was adopted to explore the rules of Chinese sentence comprehension in the foreign student at primary level, see [8] in the references. At what speed do the foreign students at secondary level comprehend Chinese sentences? This is a research problem with significant application. Sentences are the most basic units in language use, and for the foreign students Chinese sentences play an important role in communication. Their speed of comprehending Chinese sentences has a direct effect on which teaching form and level of the courses (including the specialty courses) they can accept. In the domestic TCFL (Teaching Chinese as a Foreign Language), there have been disputes all along on how to organize teaching for the foreign students, especially those undergraduates at secondary level. Whether to allow them to directly enter into specialty colleges and departments and study together with the Chinese students, or to organize independent classes for them? Different universities take different ways. The point here is whether the teaching organization suits the students' learning ability. If yes, it's likely to receive good teaching results, otherwise it might impose negative effects on their specialty study. While this can be distinguished by finding whether there are distinct differences between the foreign students and the native

Chinese-speakers in comprehension of Chinese sentences. If there are none, it indicates that they don't have language barriers when studying in the same class with the Chinese students. But if there are, it means the effects might not be ideal if they study in the same class with the Chinese students.

In the field of language acquisition, one important approach is to study acquisition by analyzing the behaviors of the subjects during language processing. This study, taking the foreign students at secondary level and the university students whose mother tongue is Chinese as subjects, and adopting the method of language experiment, explores the following two questions: whether there are distinct differences in the speed of Chinese sentence comprehension between the foreign students and the university students whose mother tongue is Chinese. And what's the difference among different types of foreign students. As inhibition occupies an important position in the process of sentence comprehension of foreign students not at a high level, therefore this study explores the reasons for the results particularly from the point of suppressing unsuitable information.

2. Method. The study was designed in a mixed way with two independent variables (a mixed designed). For the categories of the subjects, it's the between-subjects independent variables which divided the subjects into four groups, while for the categories of constructions of sentences, the within-subjects independent variables were adopted and ten constructions were included. Please refer to the details in 2.1 and 2.2.

2.1. Subjects. This study included four groups of subjects. The foreign students that constitute a major part in TCFL were chosen, including those whose mother tongues are respectively English, Japanese and Korean respectively (hereinafter referred to as English subjects, Japanese subjects and Korean subjects). There were 20 persons in each group and 60 in total. The foreign students in these 3 groups have learned Chinese for more than two years and are at secondary level, which was defined according to their language testing scores by their universities. They should understand the words and grammar items, level A to C. These foreign students come from Fudan University, East China Normal University, and Anhui University, aged from 20 to 33. Besides, a fourth group of 20 university students whose mother tongue is Chinese were chosen as a comparison group (hereinafter referred to as Chinese subjects). These subjects are from Anhui University at the age of 17-19. All the subjects participated the study voluntarily and were paid. The above number of persons refers to those who actually appeared in the statistics and analysis, and those whose performance in language experiment didn't comply with the requirements were already canceled.

For the 3 groups of foreign students, the characters of their mother tongues relate to the Chinese characters in different degrees. There is no connection between English and Chinese characters. Both Japanese and Korean characters are linked to Chinese characters, but for the former this link is much stronger. Viewing from the grammatical types (this means the division of languages according to the grammatical relations of sentences) of the mother tongues of these 3 groups of foreign students, English is the language in which

subject is prominent, in Japanese and Korean both topic and subject are prominent, while in Chinese it is topic that is prominent. This view can be found [9] in the references section.

2.2. Materials. In Mandarin Chinese simple sentences, the format that includes one verbal component and two nominal components (hereinafter referred to as VP and NP1, NP2) is used very frequently. Among all the simple sentences and verbal predicate sentences in intensive reading textbooks of TCFL, the usage frequencies are respectively around 55% and 73%, and they occupy a very important position in sentence acquisition by the foreign students. For the frequencies, see [10] in the references. In this study ten constructions of sentences were chosen according to the following factors: order of NP and VP, whether “Ba” “Bei” are used in sentences, the balance of animacy difference of NP1 and NP2, the balance of location distribution of agents (to avoid that the subjects may incur regular tendency reaction in experiment), etc. To facilitate description and tabulating, in the main text and relevant tables we’ll name them in brief respectively as SVO1, SVO2, SOV3, SVA, TC1, TC2, Ba1, Bei, Ba2, BeiBa. Please see the names and example sentences in Table 1.

TABLE 1 NAMES AND EXAMPLE SENTENCES OF 10 CONSTRUCTIONS

Names	Example Sentences
SVO1	校长昨天在这家宾馆招待了我们。
SVO2	院长在办公室会见外国来的朋友。
SVO3	在学校的时候，老师们只好吃食堂。
SVA	今天上午，他来了两位以前的同学。
TC1	他们工作计划现在已经制订出来了。
TC2	那家餐厅的名字我们现在想起来了。
Ba1	刚才，奶奶把她仔细地打扮了一下。
Bei	读者曾经被这篇文章的观点所吸引。
Ba2	这么多的汉字把留学生写得手酸了。
BeiBa	小李也被一个朋友把他骗了一回。

The 10 constructions in Table 1 can be approximately summed up into three classes. SVO1, SVO2, SOV3, and SVA go into the first class. This construction conforms to the typical Chinese syntactic structure NP1+VP+NP2, and is close to English in syntax, but differs obviously from Japanese and Korean in which verbs are located at the end of sentences. In SVO2 there is a more complicated verbal component defining the object, and part of its structure is close to that in Japanese and Korean, but different from that in English. Semantically, SVO1 and SVO2 comply with the typical semantic structure of sentences NP_{agent}+VP+NP_{patient}, while SVO3 embodies a non-typical semantic relationship, and SVA is with the semantic sequence being NP_{patient} +VP+NP_{agent}, completely contrary to the typical semantic relationship of subject-verb-object. TC1 and TC2 belong to the second class. These two constructions are not consistent with the typical construction of Chinese syntax, with the verb postposed. They are similar to the syntactic rules in Japanese and Korean and differ greatly from those in English. Pragmatically, the apparent topic property

is also close to that in Japanese and Korean. Ba1, Bei, Ba2 and BeiBa are among the third class. These constructions have morphological markings and topic properties, but they don't conform to the typical form of Chinese syntactic structure, with the verb postposed, they are similar to the syntactic rules in Japanese and Korean and differ greatly from those in English. And in pragmatics the apparent topic property is also close to that in Japanese and Korean. The difference between Ba1 and Ba2 lies in that the form marking "Ba" reflects two opposite semantic functions, with the former having a much higher usage frequency than the latter. Beiba is a mix of Bei structure and Ba structure, but in whole what it embodies is passiveness with disposal meaning. This construction is mainly used to express some complicated contents and its usage frequency is very low. The form markings of "Bei" and "Ba" in Bei and BeiBa both hint a high degree of semantic function mapping. Besides, the agents in Bei are usually nouns with a low animacy.

According to the requirements of experiment, two sentence databases were designed for the 10 constructions of sentences including exercise sentences and test sentences. Before the design, 6 university students whose mother tongue is Chinese were invited to evaluate the grammaticality of both the exercise sentences and test sentences to be used in the software. The subjects gave scores to these sentences based on a five-point scale, and finally the sentences with a score of above 4.5 were chosen. The length of these sentences (with punctuations included) was about 15 Chinese characters.

The exercise database had totally 10 sentences, each representing 1 construction. In the test database there were 10 sets of sentences and 9 sentences in each set representing 1 construction, so the total number of sentences was $9 \times 10 = 90$. Each sentence was numbered according to the construction and the database it belonged to. According to the standards stipulated in "A General Outline of the Chinese Level of the Glossaries and Characters" and "A General Outline of the Chinese Level of the Level Standards and Grammars" compiled by the Chinese Level Test Dept of the National Office for Teaching Chinese as a Foreign Language of the People's Republic of China, the grammatical level for SVO1 and Beiba was respectively primary and senior (the words and characters were all secondary level), for the rest of the 8 constructions, secondary-level characters and grammatical items were used in all the sentences in the two databases. For more information on the standards, see [11-12] in the references section at the end of this article.

2.3. Equipment and Procedure. In this study a special language experiment software was designed and operated by the subjects on a Pentium IV laptop. In the experiment reaction time and chosen answer for each sentence were self-recorded by examining the subjects' reaction to different sentences in the task of agent identification. Before the experiment, each subject was given an instruction printed in both his mother tongue (English, Japanese or Korean) and Chinese, with example explanations to the agent. The experiment was conducted only after the subjects understood the meaning of the instruction.

Before the presentation of each sentence, the computer screen was black. Afterwards, a cue signal appeared amid and above the location the sentence to be presented, the signal was in No.3 Song style, black-based and white-colored, and stayed for 750 milliseconds.

Then amid and below the signal, the sentence and its possible answers would be presented in two lines. The sentences used in the experiment would be presented in computer in the following format (take SVA as an example):

今天上午，他来了两位以前的同学。

1. 他 2. 同学 3. 不好确定

For each sentence, all the components would be presented at the same time, and the characters were in No.3 Song style, black-based and white-colored. 100 milliseconds later, the possible answers would follow. The instruction asked the subjects to press a certain key of the 1, 2, and 3 on the keyboard (1, 2, and 3 respectively corresponded to the three possible answers) as accurately and quickly as possible to identify the agent of the sentence presented. The sentence and answers would stay on screen until the subjects pressed the reaction key, after which the screen would be cleared and next sentence would be presented in 2 seconds. Each sentence and its possible answers were regarded as a whole and presented at random. Before the formal test, there was a trial test in which the sentences and answers were presented exactly in the same way as in the formal test. In the experiment, the subjects were asked to put their fingers at a fixed position of the keyboard all along the time to avoid any possible error. The formal test took about 16 minutes.

3. **Result.** Considering that the subjects might balance speed and accuracy during the experiment, we afterwards made matching comparisons between the choice rates of the accurate items (related to accuracy) and uncertain items (concerned with the subjects' possible sacrifice of accuracy to speed). After thorough analyses, we found that in most of the sentences the subjects' choices rates differed significantly. There weren't distinct differences among the 3 groups of foreign students in SVA and the Japanese subjects in Bei, they were mainly concerned with the specialty of the grammatical constructional rules of their mother tongues, not that the subjects sacrificed accuracy to quickness, therefore both reaction time and accuracy data were valid.

The experiment got two databases of reaction time and accuracy. As we attend to the subjects' comprehension speed, only reaction time was analyzed. Please refer to Table 2 for the result of the reaction time in comprehending these 10 constructions of sentences by the foreign students at secondary level and the Chinese subjects.

Using SPSS11.5 to make variance analysis, multiple comparisons of the average time (Table 3) found that the differences in reaction time between the foreign students at secondary level and the Chinese subjects lied in the following two points:

Firstly, whether Chinese is the mother tongue or not. There were significant differences between the English, Japanese, Korean subjects and the Chinese subjects in the comprehension of all the constructions of sentences ($p \approx 0.000 < 0.001$) except the TC1 in which the difference between the Chinese and Korean subjects was $p = 0.018$.

Secondly, the differences were connected with the grammatical type of the foreign students' mother tongues. Except Ba1, Bei and BeiBa, there were significant differences between the English subjects and the Japanese or Korean subjects in comprehending all the rest of the 7 constructions of sentences with $p < 0.05$. The above constructions with

significant differences in reaction time were all connected with the grammatical type of the subjects' mother tongues, i.e. the English subjects differed from the Japanese or Korean subjects, while there was no significant difference between the Japanese subjects and the Korean subjects whose mother tongues have closer grammatical rules.

TABLE 2 SUBJECTS' REACTION TIME (MS) ON 10 CONSTRUCTIONS *

Constructions of Sentences	Kinds of Subjects			
	Chinese Subjects (n = 20)	English Subjects (n = 20)	Japanese Subjects (n = 20)	Korean Subjects (n = 20)
SVO1	2674	8563 (5889)	6295 (3621)	6489 (3815)
SVO2	2915	9180 (6265)	6259 (3344)	6690 (3775)
SVO3	2979	9259 (6280)	7488 (4509)	8192 (5213)
SVA	3493	9779 (6286)	7837 (4344)	7990 (4497)
TC1	4849	12347 (7498)	8276 (3427)	8901 (4052)
TC2	3246	10587 (7341)	7494 (4248)	7995 (4749)
Ba1	3593	8657 (5064)	7520 (3927)	8051 (4458)
Bei	4412	10363 (5951)	8994 (4582)	9016 (4604)
Ba2	3939	10582 (6643)	8527 (4588)	9068 (5129)
BeiBa	4194	8213 (4019)	8035 (3841)	8293 (4099)

Note: For each construction, the first line shows the average reaction time of each group of subjects. The number in brackets on the second line means the difference of reaction time between the foreign students and the Chinese subjects.

On the other hand, the relationship between the characters of the foreign students' mother tongues and Chinese characters also affected the result, as identification and comprehension of words and characters are indispensable in sentence comprehension. At the early stages of second language acquisition, vocabulary of the mother tongue has a closer relationship with semantic concepts than the second language vocabulary, his view see [13] in the references. Another study of the author (The research is supported by grants from the National Office for Teaching Chinese as a Foreign Language of the People's Republic of China Award BK01-05/001, articles in press)found that when interfered by a phonetic radical, the average reaction time of the Japanese, Korean and non-Chinese subjects (those whose mother tongues are English, French and other phonetic languages, belonging to the same class as the English subjects in this study in terms of the nature of the characters) in judging the phonetic category of two Chinese characters presented

TABLE 3 MULTIPLE COMPARISONS OF RT(MS) OF THE TEN CONSTRUCTIONS OF FOREIGN STUDENTS AND CHINESE SUBJECTS *

Constructions of Sentences	Kinds of Subjects (I)	Kinds of Subjects (J)	<i>MD(I-J)</i>	<i>SE</i>	<i>p</i>
SVO1	Chinese Subjects (<i>n</i> = 20)	English Subjects (<i>n</i> = 20)	-5889	577	0.000*
		Japanese Subjects (<i>n</i> = 20)	-3621	577	0.000
		Korean Subjects (<i>n</i> = 20)	-3815	577	0.000
	English Subjects	Japanese Subjects	2268	577	0.007
		Korean Subjects	2074	577	0.040
SVO2	Chinese Subjects	English Subjects	-6265	618	0.000
		Japanese Subjects	-3344	618	0.000
		Korean Subjects	-3775	618	0.000
	English Subjects	Japanese Subjects	2921	618	0.001
		Korean Subjects	2490	618	0.018
SVO3	Chinese Subjects	English Subjects	-6281	721	0.000
		Japanese Subjects	-4509	721	0.000
		Korean Subjects	-5213	721	0.000
	English Subjects	Japanese Subjects	1771	721	0.008
		Korean Subjects	1942	693	0.019
SVA	Chinese Subjects	English Subjects	-6285	693	0.000
		Japanese Subjects	-4344	693	0.000
		Korean Subjects	-4496	693	0.000
	English Subjects	Japanese Subjects	1942	693	0.019
		Korean Subjects	4071	1099	0.001
TC1	Chinese Subjects	English Subjects	-7497	1099	0.000
		Japanese Subjects	-3427	1099	0.000
		Korean Subjects	-4051	1099	0.018
	English Subjects	Japanese Subjects	4071	1099	0.001
		Korean Subjects	3093	834	0.001
TC2	Chinese Subjects	English Subjects	-7341	834	0.000
		Japanese Subjects	-4248	834	0.000
		Korean Subjects	-4749	834	0.000
	English Subjects	Japanese Subjects	3093	834	0.001
		Korean Subjects	1513	511	0.004
Ba1	Chinese Subjects	English Subjects	-5064	531	0.000
		Japanese Subjects	-3927	531	0.000
		Korean Subjects	-4458	531	0.000
Bei	Chinese Subjects	English Subjects	-5951	689	0.000
		Japanese Subjects	-4582	689	0.000
		Korean Subjects	-4604	689	0.000
Ba2	Chinese Subjects	English Subjects	-6642	511	0.000
		Japanese Subjects	-4588	511	0.000
		Korean Subjects	-5129	511	0.000
	English Subjects	Japanese Subjects	2055	511	0.000
		Korean Subjects	1513	511	0.004
BeiBa	Chinese Subjects	English Subjects	-4020	658	0.000
		Japanese Subjects	-3841	658	0.000
		Korean Subjects	-4099	658	0.000

Note: 1. Based on observed means. The mean difference is significant at the .05 level.

2. 0.000 is approximate value of *p* in the table.

asynchronously was respectively 864, 988 and 1077 milliseconds. Multiple comparisons found that the differences between the Japanese subjects and the Korean, non-Chinese subjects were respectively $p = 0.001$ and $p < 0.001$, while that between the Korean subjects and the non-Chinese subjects was $p = 0.049$. Relevant domestic study also found similar results, see [14] in the references. These studies indicated that affected by the different degrees of relationship between the characters of the subjects' mother tongues and Chinese characters, the Japanese subjects could understand Chinese words and characters more easily than the Korean subjects and the Korean subjects more easily than the English subjects. Affected by this factor, we could list the reaction time of these 3 groups of foreign students in comprehending all the constructions of Chinese sentences as $RTJS < RTKS < RTES$.* In this sequence, there was no significant difference between the Japanese subjects and the Korean subjects. In some of the constructions, the English subjects differed significantly from both the Japanese subjects and the Korean subjects, and in some others they only showed significant difference from the Japanese subjects. In comprehension of sentences and identification of words and characters, all the 3 groups of subjects showed same difference tendency of reaction time, and the different difference level of comprehension of sentences was due to the effect of the grammatical rules.

The English subjects had shorter reaction time than the Korean subjects when comprehending BeiBa construction (see Table 2). As English is a language with rich morphological markings and changes, it's easier for the English subjects to process the morphological markings of "Bei" "Ba" in Chinese which are similar to those in English. Relevant study found the reaction time of the English subjects in comprehending Chinese sentences with no agent-patient marking was longer than those with the marking, and this time difference was quite significant, being $p < 0.052$, contrary to the reaction tendency of the other 3 groups of subjects, see [15] in the references. Different from Ba2, the two form markings in BeiBa construction are at the same time reliable clues to judge agent (word after "Bei") and patient (word after "Ba"), and this compound function made the English subjects have the shortest reaction time when comprehending this construction.

4. Discussion. Two problems would be discussed in this part. The first one was the automaticity degree of the foreign students in comprehension of Chinese sentences, with the Chinese subjects as reference. Then we would discuss the reasons for the differences in comprehension speed among the 3 groups of foreign students, as well as its application.

4.1. Automaticity degree of the foreign students in comprehension of Chinese sentences. Viewing from the index of variable of reaction time of these 4 groups of subjects in comprehension of these constructions of sentences, the difference between the Chinese subjects and the foreign students was bigger than that among the 3 groups of foreign students, and the reaction time of the Chinese subjects was much shorter than those of the 3 groups of foreign students. In Table 2, the bracketed numbers in the second line of each

* RTJS, RTKS and RTES are respectively short for reaction time of the Japanese subjects , the Korean subjects and the English subjects.

construction were the differences of the average reaction time between the 3 groups of foreign students and the Chinese subjects. In comprehension of all the constructions, the reaction time of the Japanese subjects was the shortest among the 3 groups of foreign students. Comparing the average reaction time (the number in the first line) of the Japanese subjects in comprehension of each construction and the difference (numbers in brackets in the second line) between the average reaction time of the Japanese subjects and that of the Chinese subjects, except that the reaction time of the Japanese subjects in TC1 and BeiBa was respectively 1.7 and 1.9 times longer, the time in all the rest of constructions was more than 2 times longer than that of the Chinese subjects. The difference of reaction time between the Chinese subjects and the Korean subjects in comprehension of TC1 was 0.018, in the rest of the constructions the reaction time of the Chinese subjects differed significantly from the English, Japanese and Korean subjects, being less than 0.001 (see Table 3). Thus we could see that compared with the Chinese subjects, the automaticity degree of the foreign students at secondary level was still low, and it's likely that their knowledge about Chinese was mainly declarative, his view see [1] in the references.

Analyzed from the language factors in this study, the reason for this low automaticity possibly lied in the fact that the grammatical rules of the foreign students' mother tongues as well as their characters affected their comprehension of Chinese sentences. Viewing from the grammatical rules of the subjects' mother tongues, Chinese differs significantly from both English and Japanese, Korean. In respect of the characters of the subjects' mother tongues, English, Japanese and Korean are all phonetic characters, while Chinese is not. It's possible that the differences in grammatical rules and characters made the 3 groups of foreign students process Chinese sentences at a low automaticity degree. For learners not at a high Chinese level, whether in comprehension or production, the knowledge they can activate in Chinese is less than that in their first language. At this point, if the learners' mother tongues differ significantly from Chinese in grammatical type and characters, the unsuitable knowledge they need to inhibit in their mother tongues is much more than that in the second language. In this way, when processing Chinese sentences, they need to assign more cognitive resources to inhibition, which in turn affects their processing speed of Chinese sentences. But with the improvement of their Chinese level, more correct knowledge can be activated and less cognitive resources are assigned to inhibition, thus the learners can fulfill their task at a higher speed and the automaticity degree of processing will be gradually improved.

4.2. The reason for the different speeds of the foreign students in comprehension of Chinese sentences and its application. This study found that when comprehending Chinese sentences there was difference not only between the foreign students and the Chinese subjects, but also among the different groups of foreign students. From Table 3 we could see clearly the rule that the difference in comprehension of Chinese sentences by different foreign students was closely related to the grammatical type of their mother tongues, namely, there was difference between the English subjects and the Japanese or the Korean subjects. This result testified the rule shown in the comprehension and production of Chinese sentences by the English, Japanese and Korean students in the past studies. For

more results on this topic, we refer readers to [8,16] and the references therein.

Except grammatical type, the different relationship between the characters of the foreign students' mother tongues and Chinese also affected the comprehension as identification and comprehension of words and characters are necessary processes of sentence comprehension. Although the characters of English, Japanese and Korean all belong to phonetic characters, their relationships with Chinese are different. English character basically has no relationship with Chinese character, while both Japanese and Korean have ever used or modified Chinese characters to record their languages in history, thus both of them are closely related to Chinese characters and belong to the cultural circle of Chinese characters. In modern Japanese, quite a lot of words and characters relate in different degrees to Chinese characters in form, pronunciation and meaning. Modern Korean characters belongs to phonetic character, and its writing is in squares form, but due to its borrow of Chinese characters in history, some words and characters in Korean have phonetic and semantic relations with Chinese characters. Besides, the Korean government permits that 1300 commonly used Chinese characters can be in mixed use with Korean characters(Korean in the front, then the relevant corresponding Chinese characters follow in brackets). Speaking generally, Japanese has a stronger relationship with Chinese than Korean. Therefore, the Japanese subjects could comprehend Chinese characters more easily than the Korean subjects, while the Korean subjects more easily than the English subjects.

Relevant overseas study found that at the early stages of second language acquisition, words of mother tongues have a closer relationship with the semantic concepts than those of the second language, and the latter relate to the semantic concepts mainly via the former. Afterwards, as the learners gradually get familiar with the second language, the relationship between its vocabulary representations and the representations of the semantic concepts also strengthens, and the words of the second language can directly access the representations of the semantic concepts, but their relationship with the semantic concepts is still not as strong as the words of the mother tongues, see [13] in the references section. The result of domestic study on non-proficient Chinese-English bilingual adults also supported this view, see [17] in the references.

Under the joint effects of the differences in relationship with the Chinese characters and relevant grammatical rules, the 3 groups of foreign students showed differences when comprehending the same Chinese sentence, and this difference changed with the change of their Chinese level. Relevant study found that when the foreign students at primary level comprehended Chinese sentences, the reaction time of the English subjects differed significantly from the Japanese and Korean subjects in all of the constructions of sentences, being at $p < 0.001$, see [8] in the references. But for the subjects at secondary level, there was significant difference between the English and Japanese or Korean subjects only in 7 of the constructions of sentences. In comparison, the number of items with difference lessened and difference degree also weakened. It's possible that at different stages of Chinese level, the difference between the characters of the foreign students' mother tongues and Chinese, and the difference between the grammatical rules of the foreign students' mother tongues and corresponding Chinese rules functioned differently.

The above foreign students at secondary level showed two significant differences in 7 constructions of sentences. The first one was that the English subjects differed significantly from the Japanese, Korean subjects in SVO1, SVO2 and Ba2. The other one was that in SVO3, SVA, TC1 and TC2, the English subjects differed significantly only from the Japanese subjects.

Firstly, let's look at the first difference: there was significant difference between the English subjects and the Japanese, Korean subjects in 3 constructions of sentences.

In comprehension of SVO1, the reaction time of the English subjects was longer than that of the Japanese or Korean subjects, respectively being 8563, 6295 and 6489 milliseconds (see Table 2), and the difference level was respectively $p = 0.007$ and $p = 0.040$ (see Table 3). The structure of SVO1 is very typical in Chinese sentences and used very frequently, and the subjects have more chances to get it strengthened during study, therefore compared with other constructions it's easier for the 3 groups of foreign students to comprehend this one (the reaction time of the English and Japanese subjects in this construction was slightly longer than in BeiBa and SVO2, but there was no significant difference between the English and Japanese subjects in these 2 constructions). Similar to the finding in this study that when comprehending Chinese as a second language the constructions of sentences with a high usage frequency are more easily activated, other domestic studies on processing of Chinese words and sentences also found that it's more difficult for the Chinese subjects to suppress the primary meaning (at high usage frequency) than the secondary meaning of ambiguous words and sentences, the former could be activated within a shorter time and the relevant structure could be developed, while it took a longer time for the latter to be activated and extracted. For more results on this topic, we refer readers to [4,18-19] and the references therein.

The usage frequency of SVO2 is also high in Chinese. The reaction time of the 3 groups of foreign students in this construction was similar to that in SVO1, with the English subjects' longer than that of the Japanese and Korean subjects. The reaction time of the 3 groups was respectively 9180, 6259 and 6690 milliseconds, and the difference level was $p = 0.001$, $p = 0.018$. The main reason for this result was similar to that for SVO1. Besides, in SVO2 NP2 has a more complicated verbal definer, in English this kind of definer is usually located after the definiendum, in sharp contrast with Chinese, Japanese and Korean in which it's before the definiendum. It was likely that the postposition of the definer in English suppressed the English subjects' extraction of it in Chinese, thus affecting the English subjects' speed in comprehension of SVO2 and making their reaction time in this construction longer than that in SVO1.

The reaction time of the English subjects in Ba2 was longer than that of the Japanese, Korean subjects, being respectively 10582, 8527, 9068 milliseconds and the difference level was $p < 0.001$, $p = 0.004$. The reason for the longer reaction time in this construction was mainly that in semantic function the mapping degree of the form marking "Ba" was higher for "marking before patient" than "marking before agent", and this caused the competition between the two opposite semantic functions of "Ba" in comprehension. When comprehending this construction, the 3 groups of subjects needed to suppress the irrelevant

information in Chinese —— “Ba” is usually “marking before patient”, thus a longer reaction time was needed. Besides, in this construction VP is located at the end of sentence while in English it’s amid NP1 and NP2, so the English subjects also needed to suppress the interference of the relevant rules of their mother tongue, therefore their reaction time was the longest.

Now let’s look at the second difference: the English subjects differed significantly only from the Japanese subjects in the comprehension of 4 constructions.

In SVO3, the English subjects’ reaction time was longer than that of the Japanese subjects, being respectively 9259 and 7488 milliseconds, and the difference level was $p = 0.008$. Compared with SVO1, the NP2 in SVO3 was a kind of non-typical patient, and when comprehending this non-typical agent- patient relationship, the subjects usually needed to suppress the typical agent- patient relationship contained in many sentences, which affected the subjects’ comprehension speed and resulted in a longer reaction time in this construction than in both SVO1 and SVO2.

In SVA, the English subjects’ reaction time was longer than that of the Japanese subjects, being respectively 9779, 7837 milliseconds, and the difference level was $p = 0.019$. Their performance in this construction and the reason for this result were both similar to those in SVO3. Besides, NP1 and NP2 in SVA are both nouns with a high animacy and can act as agents. In this construction, NP2 is the actor of the action, namely a agent, but NP1 is not only the starting point of the narration (starting point of narration in sentence is usually the agent) but also lies before VP. When comprehending this construction, the subjects needed to suppress choosing NP1 as agent, which affected their speed in choosing NP2 as agent, and as a result the reaction time of both groups of subjects in this construction was longer than that in SVO1 and SVO2.

In TC1, the English subjects’ reaction time was longer than that of the Japanese subjects, being respectively 12347, 8276 milliseconds, and the difference level was $p = 0.001$. The structural ambiguity of this construction caused the 2 groups of subjects to consider two different structures in comprehension: they built one structure and then after finding there was no agent in it, they turned to build another one with agent; or they built two different structures at the beginning and suppressed one in the following comprehension. Either of these two situations would lengthen their reaction time. Besides, in this construction VP is located at the end of the sentence, obviously different from the syntactic structure of NP1+VP+NP2 in English sentences, thus when comprehending this construction the English subjects had to suppress the interference of the syntactic rules of English and as a result their reaction time was the longest.

In TC2, the English subjects’ reaction time was longer than that of the Japanese subjects, being respectively 10587, 7497 milliseconds, and the difference level was $p = 0.001$. The performance of the 2 groups of subjects in TC2 was similar to that in TC1, but the reaction time was shorter. This construction was different from TC1 in that there was no ambiguity, only that patient was at the beginning of the sentence, thus the reaction time in this construction was shorter than that in TC1. Besides, in this construction VP lied at the end of the sentence which was greatly different from the relevant syntactic rules in English,

thus when comprehending this construction the English subjects also needed to suppress the interference of the relevant syntactic rules of their mother tongue and therefore their reaction time was longer.

Second language processing is a procedure including activation of relevant information and suppression of irrelevant information. For the foreign students who are not at a high Chinese level, when comprehending Chinese sentences suppression is more important and the suppressed irrelevant information is from both their mother tongues and Chinese. In the above 7 constructions with significant differences, the irrelevant information the subjects suppressed in comprehension of a certain construction sometimes was not single. It might come from their mother tongues, or from Chinese. For example, when comprehending Ba2 the English subjects might need to suppress both the interference from Chinese that “Ba” is usually “marking before patient”, and the effect of the grammatical rules of their mother tongue English in which VP is usually amid NP1 and NP2. For the foreign students, when comprehending a certain Chinese construction, if they were interfered by irrelevant information which wasn't suppressed in time and a new redundant construction was established, their establishment of the correct structure was then affected and as a result they needed more time in processing. On the other hand, it's likely that because of their low speed in activating suitable information, they spent more time at the stages of founding and mapping (affected by the characters of their mother tongues, it took more time to access the meaning of the corresponding Chinese words and characters).

With the upsurge of learning Chinese both domestically and overseas, how to enable the foreign students to learn Chinese well within a short period of time is a very important question for the TCFL. The precondition for the resolution of this question is that the teaching content and method must comply with the foreign students' rules of Chinese acquisition. Currently, in TCFL in our country, classification teaching is mainly organized according to the different Chinese levels of the foreign students. However, this organization method encounters difficulties in solving some problems such as the students come from different countries and their situations are very complicated, eventually resulting in the weakening of the basic principle of teaching students in accordance of their aptitude. Among all the problems, teaching by classification is the most outstanding. Domestic experts had ever proposed that we compile syllabuses and textbooks, and improve teaching method and testing according to the characteristics of the learners' mother tongues, thus to actually realize the aim of the basic teaching principle, their opinions can be found [20-21] in the references section. Viewing from the results of this study, the foreign students' automaticity degree was still low compared with the Chinese subjects. Although these foreign students have reached a rather high Chinese level, compared with the students whose mother tongue is Chinese, there was still a significant difference. This would bring them some difficulties after they enter into specialty colleges and departments and learn specialty knowledge together with the Chinese students. Therefore, for these foreign students who need to learn specialty knowledge, it's necessary to organize teaching independently. Moreover, from the rules of their comprehension of Chinese sentences it could be seen that after their level was substantially improved, we could determine a

suitable class-organization and carry out teaching according to their actual differences.

Viewing from the results of the foreign students' difficult degree in suppressing a certain grammatical rule (irrelevant information) in the comprehension of Chinese sentences, Chinese grammar teaching to foreigners should be pertinent, and those grammatical rules which are difficult to master should be especially strengthened during teaching. Although some Chinese grammatical rules differ greatly from the relevant ones in the foreign students' mother tongues, they are used very frequently in Chinese and make it easier for the foreign students to suppress the interference from the irrelevant rules of their mother tongues. This tells us that we can remove the difficulties brought to the foreign students by strengthening the input rate of these rules.

5. Conclusions. Through the above analyses, we could conclude this study as follows:

Compared with the native Chinese speakers, the speed of comprehension of Chinese sentences by the foreign students at secondary level was relatively lower, and there was a significant difference between their speeds. This result indicates that although the Chinese ability of the foreign students at secondary level has reached a certain degree, the teaching result might not be ideal if they were put in the same class with the university students whose mother tongue is Chinese.

The speed of comprehension of Chinese sentences by the foreign students at secondary level was related to the typology of their specific mother tongue, and there were significant differences between the English students and the Japanese or Korean students. On the other hand, the difference between the characters of the foreign students' mother tongues and Chinese characters also affected their comprehension of Chinese sentences. These results implied that we could determine a suitable class-organization and carry out teaching according to the foreign students' actual differences when they have reached a higher Chinese level.

Comprehension of Chinese sentences by the foreign students is a research topic study that involves various factors and has important practical application, this study only made some preliminary explorations in this regard. In the future we shall make more rigorous designs and take more advanced methods to study the relevant important problems in a deeper degree.

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REFERENCES

- [1] Anderson J. The architecture of cognition. Cambridge, Mass: Harvard University Press, 1983.
- [2] McLaughlin B, Heredia J L C. Information processing approaches to research on second language acquisition and use. In: Ritchie W C, Bhatia T K eds. Handbook of Second Language Acquisition, San Diego: Academic Press, 1996.
- [3] Gernsbacher M A, Faust M E. Skilled suppression. In: Dempster F, Brainerd C J eds. Interference and inhibition in cognition. San Diego, CA: Academic Press, pp. 295-327, 1995.
- [4] Chen Y M, Cui Y. Processing of Chinese sentence ambiguity (in Chinese). Acta Psychologica Sinica, vol.29, no.1, pp.1-7, 1997.
- [5] Yang L X, Chen Y M. Inhibitory mechanism in self-paced sentence processing (in Chinese). Acta Psychologica Sinica, vol.34, no.6, pp.553-560, 2002.
- [6] Jing S J, Miao X C. The inhibition mechanism of skilled and less skilled language comprehenders of high school students in Chinese (in Chinese). Psychological Science, vol.26, no.1, pp.67-70, 2003.
- [7] Miao X C. Word order and semantic strategies in Chinese sentence comprehension. International Journal of psycholinguistics, vol.8, pp.109-122, 1981.
- [8] Wang Y D. Comprehending the Chinese sentences by the foreign students whose native languages are different in typology(in Chinese). Applied Linguistics, vol.51, no.3, pp.120-126, 2004.
- [9] Li C, Thompson S. Subject and topic: A new typology of language. In: Li C ed. Subject and topic. New York: Academic Press, pp.457-490,1976.
- [10] Zhao S H, Liu S H, Hu X. Statistics of the constructions of Chinese sentences in the main texts of the modern Chinese's textbook of Beijing Language Institute (in Chinese). Language Teaching and Linguistic Studies, no.2, pp.11-26, 1995.
- [11] The National Office for Teaching Chinese as a Foreign Language of the People's Republic of China. A general outline of the Chinese level of the glossaries and characters (in Chinese). Beijing: Beijing Language and Culture University Press, pp.29-79, 322-333, 1992.
- [12] The National Office for Teaching Chinese as a Foreign Language of the People's Republic of China. A standard of the Chinese level and a general outline of Chinese grammar (in Chinese). Beijing: Higher Education Press, pp.35-88, 1996.
- [13] Kroll J F, Stewart E. Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. Journal of Memory and Language, vol.33, pp.149-174, 1994.
- [14] [14] Feng L P, Song Z M. The influence of the nature and productivity of Chinese morphemes on the morphological recognition by foreign students (in Chinese). Journal of Yunnan Normal University, vol.2, no.6, pp.33-38, 2004.
- [15] Wang Y. D. Effects of Markedness in Chinese Sentences on Foreign Students' Comprehension. (in Chinese). Psychological Science, vol.29, no.2, pp.443-447, 2006.
- [16] Wang Y D. The comparison of the production of Chinese sentences in foreign students whose native languages are different in typology (in Chinese). Acta Psychologica Sinica, vol.36, no.3, pp.274-280, 2004.
- [17] Guo T M, Peng D L. The accessing mechanism of the less proficient Chinese-English bilingual's

- conceptual representation (in Chinese). *Acta Psychologica Sinica*, vol.35, no.1, pp.23-28, 2002.
- [18] Shu H, Tang Y H, Zhang Y X. A study on the resolution of lexical ambiguity of two-syllable homophones in Chinese (in Chinese). *Acta Psychologica Sinica*, vol.32, no.3, pp.247-252, 2000.
- [19] Zhou Z J, Chen Y M, Yang L X. Inhibition for ambiguous word inappropriate meaning (in Chinese). *Acta Psychologica Sinica*, vol.36, no.6, pp.637-643, 2004.
- [20] Lu J M. Strengthening the specialty's notion for the development of CFLT (in Chinese). *Chinese Teaching In The World*, vol.67, no.1, pp.5-10, 2004.
- [21] Zhao J M. Transcending and absorbing: On the research and development of materials of CFLT (in Chinese). *Applied Linguistics*, vol.50, no.2, pp.112-113, 2004.