

The Grammar Impairment of Mandarin Chinese SLI Children: Evidence from Topic-comment Structures*

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Abstract—Acquisition of topic structure was studied in 12 Mandarin Chinese-speaking SLI children aged from 3;11-6;1 and in two other groups of children with normal language development (TDA & TDY). The study aimed to find out whether the Chinese SLI children encounter difficulties when comprehending and producing topic structures, and to locate the sources of the deficits if there are. Comprehension and Production was assessed by using one binary sentence-picture matching tasks, one elicitation production task. The findings were that while the Chinese-speaking SLI children comprehend subject topic structures around the age of 4;0, they are still at chance level in object topic structures at that age. The comprehension impairment is interpreted in the approach of Relativized Minimality as underspecification of the feature set of the moved elements. The SLI children avoid producing the target structure, instead utilizing derivationally less complex SVO sentences. The deficit in production can be accounted for by the Derivational Complexity Hypothesis.

Index Terms— SLI children, topic structures, relativized minimality, derivational complexity hypothesis

I. INTRODUCTION

The extensive studies abroad have shown that children with Specific language impairment (SLI) have severe deficits in the comprehension and production of complex structures, which involve the structural embedding and syntactic movement, as in the case of *wh*-questions (Van der Lely & Battell 2003; Deevy & Leonard 2004; Friedmann & Novogrodsky 2011), relative clauses (Håkansson & Hansson 2000; Friedmann & Novogrodsky 2004; Novogrodsky & Friedmann 2006; Jensen De López K, Sundahl Olsen L & Chondrogianni 2014) and topic structures (Van der Lely & Harris 1990). With regards to Chinese SLI children, to date, there are only two studies investigating the acquisition of complex structures. He & Yu (2013) examined the comprehension of Chinese relative clauses by using the picture selection comprehension task. They found that the Chinese SLI children encountered difficulties in the comprehension of subject relative clauses. Zeng et al. (2013) found that SLI children have a deficit in the acquisition of Chinese *BA*-construction. Van der Lely, H., Rosen, S., & McClelland, A. (1998); Van der Lely & Battell (2003); Van der Lely (2004, 2005) attributed the underlying causes of these problems to a deficit in movement operation.

Many linguists assumed that syntactic movement are required in the derivation of Chinese topic structures (Huang 1984, 1987; Shi 1992). The present article seeks to explore the acquisition of topic structures in Mandarin Chinese-speaking SLI children. The study will shed light on the possible problems in Chinese SLI children, which can provide an important window into their underlying deficit.

The significance of the present study are two fold. On the one hand, the study can verify the theories concerning the underlying causes of SLI children proposed by the previous studies. On the other hand, the investigation has significant practicality in making diagnosis and giving treatment of SLI children because Chinese is a topic-prominent language and topic structures in Chinese are productive and varied in form.

II. LITERATURE REVIEW

A. Topic Structures in Chinese

Chinese is a topic-prominent language, therefore many elements can be the topics. The present article examines the argument topic structures. The argument topic structures are derived by movement of a noun phrase from the subject or the object position to initial position of the structures and co-indexation of the topic with its trace (Huang 1984, 1987; Shi 1992). In a subject topic structures as in (1a), the noun *the mother* has moved from the subject position to the initial position of the sentence, and is co-indexed with its trace. In a object topic structures as in (1b), the noun *the mother* has moved from the object position to the initial position of the sentence, and is co-indexed with its trace. The thematic role

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of the topic in argument topic structures is assigned at the trace position, therefore one need to recognize the relationship between the trace and the moved topic in order to correctly interpret the sentence.

(1) a. Subject Topic Structures:

Mama a, zai tui xiaohai.
 mother topic marker Asp push child
 “The mother is pushing the child”

b. Object Topic Structures:

Xiaohai a, Mama zai tui.
 child topic marker Mother Asp push
 “The child, the mother is pushing”

B. Chinese Topic Structures in Typical Acquisition

The Chinese Topic structure is an underexplored area in the child language acquisition. Chien (1983) examined the sensitivity to the distinction between subject and topic by children at their early stages of language acquisition. The results indicate that children can distinguish the notions of subject and topic.

Erbaugh (1992) conducted a longitudinal study of four Chinese-speaking children and found that these children (from the age of 1;10 through 3;10) stick rigidly to canonical SVO word order. She proposed that the adherence to the canonical word order schema is due to their limited processing capacities and desire for consistency of the word order (Erbaugh, 1992).

In a corpus study, Chen (2009) examined the frequency and types of topic structures produced by young children ranging between ages 2;2 and 6;0 in spontaneous speech. The result shows that the first emergence of topic structures is as early as 2;2 and children reach adult-like level by age 4;0. However, the production of topic structures is infrequent in child speech and he proposed that the fact is partly attributed to children’s adherence to canonical word order.

In summary, the previous studies show that at an early stage of syntactic development (before the age 4), Chinese children can master topic structures, while because of the influence of canonical word order and their limited processing capacities, their production of the structure is infrequent.

Leonard (2014) hold that all areas relatively difficult for typically developing children correspond to details of language of special weakness for SLI children. Therefore it is justified to anticipate that Chinese topic structures will impose great difficulties on SLI Children than their typically developing peers. The present study aims to examine the possible problems in producing and comprehending topic structures by Chinese SLI children and to explore the causes of their underlying grammatical deficit.

III. THE EXPERIMENT

A. Comprehension of Topic Structures

Participant

Thirty-six monolingual Chinese-speaking children aged from 4;00 to 6;00 participated in the present study. The Twelve SLI children (2 girls and 10 boys) were recruited from normal kindergartens and a special education center. The recruitment has the screening phase and the testing phase.

In the screening phase, the parents and kindergarten teachers filled in *the Specific Language Impairment Checklist for Pre-school Mandarin-speaking Children* (He 2010) to select the suspected subjects. In this stage, those children who do not met the criteria for SLI as described in Leonard (2014) are also excluded. All the subjects had normal hearing ability, no otitis media with effusion, no neurological dysfunction history, no structural anomalies, no oral motor dysfunction or no symptoms of impaired reciprocal social interaction.

In the testing stage, the language ability of all children was tested on two standardized tests. The first test is *Rating Scale for Pre-school Children with Language Disorder–Revised Chinese Version 2008* (RSPLD-R), which is designed to test children’s global language ability. The other test is *Peabody Picture Vocabulary Test– Revised Chinese Version 1990* (PPVT-R), which aims to test the children’s receptive vocabulary. Children’s performance IQ was assessed with *McCarthy Scale of Children’s Abilities –Revised Chinese Version 1991* (MSCA-R). All the SLI children get standard scores 80 or above in IQ test, and at least two of the five scores in the language tests are below 1.25 SD for their age on the RSPLD-R and PPVT-R.

A control group of twelve children are selected to serve as typically-developing age-matched (TDA) children. Each child in the TDA group was within 15 days of the age of a child in the SLI group and TDA child and his matched SLI child are of the same gender.

The remaining twelve children were typically developing younger (TDY) children matched with the SLI children on their language abilities as determined by mean length of utterance (MLU). The MLU of the each TDY children was 0.3 longer or shorter than that of SLI children.

The TDA and TDY group also receive the two standardized language tests (RSPLD-R and PPVT-R) and their scores are within the normal range. In summary, all the TDA and TDY children are mentally and physically healthy and with normal language proficiency.

Experimental tasks

The task was a binary sentence–picture matching task. Two types of Chinese topic structures were used: subject topic structure and object topic structure. Examples of the sentence types are given in (2a–b).

(2) a. Baba a, zai qin nanhai; Mama ne, zai qin nuhai.

The father, is kissing the boy; whereas the mother, is kissing the girl.

b. Baba a, nanhai zai qin; Mama ne, nuhai zai qin.

The father, the boy is kissing; whereas the mother, the girl is kissing.

All the verbs in the task were all transitive verbs, and all the noun phrases were animate. All the experimental sentences were designed as semantically reversible. For each sentence, there was a pair of two colored pictures (see Fig. 1). One picture matched the sentence, whereas the other showed the reverse action. For each sentence type, there were six items, yielding twelve sentences in total.

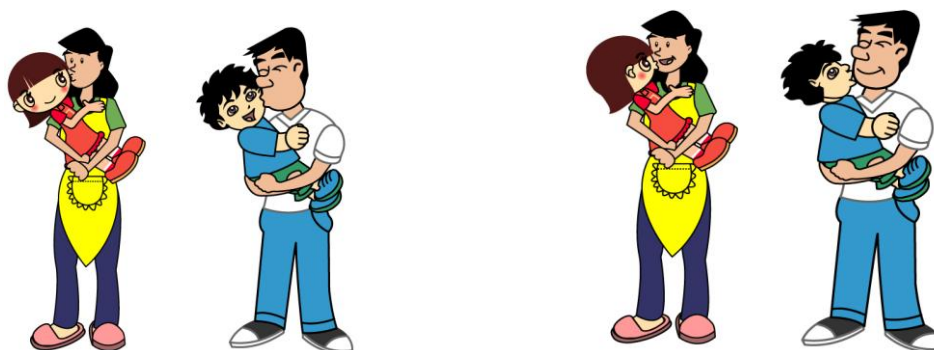


Fig. 1. A picture pair used in the sentence-picture matching task.

Procedure

Firstly the experimenter asked the children to listen carefully and to point to the picture that matched the sentences that they heard. Then the experimenter read each sentence to the participant, at the same time, presented two pictures to him (or her). The child heard the sentence and pointed to the picture that matched the sentence. Prior to the experiment stage, we conducted one training trial, during which if the children made a mistake, the experimenter pointed to the right pictures and gave explanation if necessary to ensure that the participants understood the experimental procedure. Each child heard the twelve sentences in a single session and in a quiet room in the kindergarten or special education center.

Results

As can be seen in Table 1, the performance of TDA and TDY children on both two types of sentences are above chance. Whereas, the performance of SLI group is above chance level on the subject topic structures, but on the object topic structures, the performance is at chance level. The results of one-way ANOVA shows that for the SLI group, the performance of subject topic structures were significantly better than that of object topic structures, $P=0.014<0.05$. For the TDA and TDY group, there is no significant difference between the performance of two sentence types, $P=0.166>0.05$, and $P=0.104>0.05$ respectively.

TABLE 1.
MEAN PERCENTAGE CORRECT BY GROUP AND SENTENCE TYPE

	SLI	TDA	TDY
Age	(3,11-6,1) 4,10	(3,11-6,1) 4,6	(2,11-4,11) 3,6
Subject topic structure	80%	91.6%	83.3%
Object topic structure	50%	80.3%	60%

The performance of the three groups do not have significant difference on the subject topic structures. However, on the object topic difference, there is significant difference ($F=0.841, P=0.440>0.05$). The results of Tukey HSD show that the TDA group performed significantly better than the SLI group ($p=0.011<0.05$).

B. The Elicitation Production Task on Object Topic Structure

Participant

The participants in this experiment are the same as those in the first experiment.

Materials and procedure

In the elicitation production task, object topic structures were elicited as a description of an action shown in a picture. The first two pictures both depicted an animate entity carrying out a nonreversible transitive action (e.g., Yu, xiaomao yao zhe. “the fish, the cat is taking”; Xiangjiao, houzi yao zhe. “the banana, the monkey is taking”). The third picture depicted a similar scene (e.g., Gutou, xiaogou yao zhe “the bone, the dog is taking”). (see Figure 2).



Figure 2. An example of a picture used in the picture elicitation task.

The experimenter described the first two pictures using simple sentences, and then asked a question about the third pictures, see example (3).

(3) Elicitation procedure: Here are a cat, a monkey and a dog. The cat is taking the fish, the monkey is taking the banana. What about the bone (pointing to the bone in the third picture)? Please start with “The bone ...”.

The target responses were object topic structures. There were 6 picture pairs that elicited 6 object topic structures.

Results

As can be seen in Figure 3, the performance of TDA and TDY children on object topic structures are near chance level, 44.30% and 37.60% respectively. Whereas, the performance of SLI group is far poorer than that of the control groups, they have severe difficulties in the production of object topic structures. The results of one-way ANOVA shows that the performance of the three groups have significant difference on the object topic structures ($F=4.850$, $P=0.014 < 0.05$). The results of Tukey HSD show that the TDA group performed significantly better than the SLI group ($p=0.016 < 0.05$).

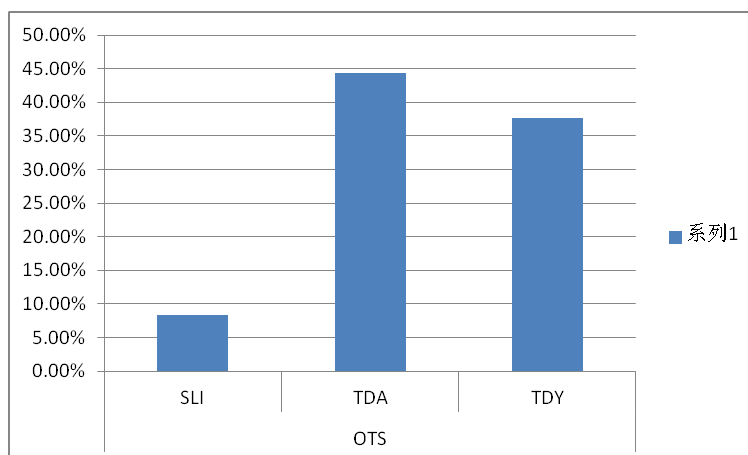


Figure 3. Production of object topic structures (OTS) in the picture description tasks.

The information on the types of errors and preferred responses can shed light on the underlying deficit of the SLI participants. The non-target responses in the tasks include canonical SVO sentences instead of object topic structures (example (4)). This accounted for 47.2% of all responses of the SLI group. The second kind of non-target response (16.6%) in the SLI group is the sentence fragments or ungrammatical sentences (example (5)). Other non-target responses included no response or irrelevant responses (13.8%) (example (6)), *SHI* sentences (11.1%) (example (7)), and passive sentences (2.7%)(example (8)).

(4) SVO sentence

Meimei na le Xiangjiao
 Younger sister take Aspect banana
 “the younger sister takes the banana”

Target sentences: The banana, the younger sister takes.

(5) Sentence fragments or ungrammatical sentences

a. Xiaodidi de xiangjiao
 Younger brother DE Banana
 “Younger brother’s banana”

Target response: The banana, the younger brother takes.

b. xiao yazi
 little duck
 “duckling”

Target response: The scarf, the duckling wears.

c. chi gou
 eat dog
 “eat the dog”

Target response: The bone, the dog eats.

(6) ta zhu zai nali.

She live Aspect there.

“He lives there”

Target response: The banana, the younger sister takes.

(7) gutou shi xiaogou chi de.

The bone SHI dog eat DE.

“it is the dog that eats the bone”

Target response: The bone, the dog takes.

(8) gutou rang xiaogou chi.

The bone let dog eat

“the bone is eaten by the dog.”

Target response: The bone, the dog eats.

The analysis of the non-target responses indicated that the SLI children used various structures to provide a task-appropriate response, without involving syntactic movement in their production. They refrained from producing the object topic structures by producing the simple sentences.

IV. DISCUSSION

A. *The Deficit in Comprehension and Production of Chinese Topic Structures*

The main finding of this study is that Chinese SLI children (4;0—6;1) do not understand object topic structures and their performance is at the chance level, whereas the children with normal language development master this structure by around age 3:0. The SLI children’s performance on the comprehension of subject topic structure is good, with no significant difference from the TDA and TDY children. The production of object topic structures was difficult to all the three groups. But the SLI children’s production is most severely impaired, they can not produce object topic structures. The other two control groups’ performance is near the chance level.

B. *The Relativized Minimality and the Deficit in Comprehension of Chinese Topic Structures*

The Relativized Minimality is postulated as a theory of syntactic locality on constraints governing extraction from syntactic islands (Rizzi 1990, 2004; Cinque 1990; Starke 2001). In the configuration of (9), a local relation between X and Y can not hold if the intervener Z is similar in structure to X.

(9) ... X ... Z ... Y ...

There are many studies concerning the RM effects in the language acquisition (Grillo 2005, 2009; Friedmann, N., Adriana & Rizzi. 2009; Belletti, A. *et al.*2012; Guasti M. T., Stavrakaki & Arosio 2012). Grillo (2005, 2009) and Friedmann *et al.* (2009) proposed that the aphasics and the younger children are insensitive to the edge feature of strong phase (CP and vP), which resulted in the underspecification of the feature set of the element moved to the specifier position of strong phase. We argue that this approach can be extended to the acquisition of topic structures by children with SLI. We anticipate that Chinese SLI children will encounter the same problem in the comprehension of the object topic structures.

The asymmetry between subject topic structures and object topic structures are caused by the intervention effect. To be more precise, in the case of object topic structures the intervening noun (the subject of the sentence) renders the establishment of the local relation between the target and the origin more difficult for SLI children.

Following Huang (1984, 1987) among others, we assume that topic structures are derived by movement. Precisely, the topic phrase is attracted by the head (topic) bearing the feature [+TOPIC, +NP] to move to the specifier of TopP. The subject and object topic structures is shown in configuration (10).

(10) a. Subject topic structure: [TopP subject Topic [+Topic, +NP] ... <subject>...object]

b. Object topic structure: [TopP object Topic [+Topic, +NP] ...subject ...<object>]

In (10a), there is no intervener between the target (specifier of TopP) and the origin (place of extraction). In (10b), the subject is an intervener between the target and the origin. In the object topic structure example *Baba a, nanhai zai qin*, the lexical NP *Baba* is the target, *nanhai* the intervener, and *qin* the origin. Because the SLI children are insensitive to the [+topic] feature of the moved topic phrase, therefore they will assume that the target and the intervener share a structural similarity. It is the existence of the intervener that makes the local relation cannot hold between the origin and the target for SLI children. However it is unclear how exactly failure to establish the local relation between the target and the origin would manifest itself in comprehension of the object topic structures.

According to Grodzinsky (1990), for individuals withagrammatic aphasia, the deficit in grammar involves inability to assign thematic roles to noun phrases that underwent movement. We propose that this theory can extend to the case of SLI children. The SLI children will fail to assign the thematic role to the topic phrase that moved from the object position of the sentence, if the local relation between the target and the origin can not establish. When an NP lacks a thematic role due to a grammar deficit, the SLI children will adopt a non-syntactic strategy to interpret this NP according to its linear position within the sentence. If the first NP has underwent movement, it is interpreted as the agent. NPs that base-generates retain their thematic roles. Therefore, the SLI children will meet trouble when comprehending

the object topic structures. Because in this structure, the first NP that has moved is a theme. The SLI children will mistakenly assume that the first NP receives an agent role. At the same time, the sentence contains a real agent (the subject of the sentence), that retained its agent role because it has not moved. In this case, The SLI children has to choose which NP bears the agent role, and is forced to guess. This is why the SLI children's performance on the comprehension of object topic structures is the chance level.

However for typically developing children, namely the TDA and TDY children in this study, this intervention effect does not occur. Because they are sensitive to the topic feature of the moved element, therefore they assume that the target and the intervener are different in feature set. This is why the TDA and TDY children's performance on the comprehension of the two types of topic structures are not significantly different.

C. *The Derivational Complexity Hypothesis and the Deficit in Production of Topic Structures*

The Derivational Complexity Hypothesis (DCH) (Jakubowicz 2004, 2005) is based on economy consideration. To be more specific, it was considered that children prefer more economical derivations and young children tend to avoid using movement because it is costly. For SLI children, Jakubowicz (2004, 2005) proposed that abnormal language development is sensitive to the computational complexity of the derivation due to the developmental constraints. Furthermore, Jakubowicz suggested that computational complexity can be estimated by a metric whereby complexity is precisely defined.

(11) Derivational Complexity Metric (DCM) (Jakubowicz, 2005)

- a. Merging α_i n times gives rise to a less complex derivation than merging α_i $(n+1)$ times.
- b. Internal Merge of α gives rise to a less complex derivation than Internal Merge of $\alpha+\beta$.

According to the DCM, in deriving a given structure, the child is sensitive to the number of times that a copy of the topic must be merged and to the number of elements that may (or must) undergo movement.

The result of the production of object topic structures by SLI children can be accounted for by DCH. The most frequent avoidance strategy used by these children is simple SVO sentences. In this construction, no syntactic movement is involved, which, by the DCM, is less complex than the object topic structures, which require the movement of the topic phrase to the specifier position of the TopP. Children show evidence of using available means to produce the task-appropriate sentences. This result is consistent with the previous studies on the acquisition of topic structures: young children (1;10-3;10) adhere strictly to canonical SVO word order (Erbaugh 1992). SLI children are in resemblance with the younger children in their syntactic capacities. This study indicates that Chinese SLI children (4;0—6;1) avoid producing topic structures, instead producing the canonical SVO sentences.

Moreover, the SLI children's avoidance strategies include *SHI* sentences (11.1%), and passive sentences (2.7%). Although the sentences involve the syntactic movement, which is as complex as the object topic structures, they occupy very limited percentage. This fact can also lead support to the DCH: SLI children's syntactic capacities are sensitive to the computational complexity of the derivation. On the contrary, the typically developed children's (both the TDA and TDY children) production of the object topic structures are around the 40%. They also utilized more avoiding strategies, which involve syntactic movement. Taken together, this result indicates that the SLI children are more sensitive to computational complexity of the derivation probably because of their limited capacity of working memory.

The DCH can also give explanation to the asymmetry of the comprehension of subject topic structures and object topic structures by SLI children. The simplified derivation of the two structures is given below:

- (12) a Subject topic structures: [_{TopP} Subject_{Top} [_{Subject} T [_{VP} [_{VP} Object]]]]
- b Object topic structures: [_{TopP} Object_{Top} [_{Subject} T [_{Object} vP [_{VP} Object]]]]

The differences lie in the different extraction sites out of which movement occurs in two structures. In the subject topic structures, the subject moved from the specifier position of TP directly to that of TopP; however in the object topic structures, the topicalization requires two steps. Because of Phase Impenetrability Condition (PIC; Chomsky 2001), the object need to move to the specifier position of the vP, then to the specifier of TopP. By the DCM, the subject topic structure is less complex than the the object topic structures.

V. CONCLUSION

The main finding presented in this paper is that Chinese SLI children aged 4;0–6;1 years comprehend subject topic structures unproblematically, whereas their comprehension and production of object topic structures may be severely impaired. The asymmetry of comprehension of the subject topic structures and object topic structures are consistent with the prediction of RM, as well as with the DCH. Because of the intervention effect, the SLI children can not assign a thematic role to the moved element in the object topic structures. Because of the derivational complexity, The comprehension and production of object topic structures are severely impaired.

Theoretically, the results bear on the claim that the RM and DCH are universal constraints regulating the language build-up. In practice, the study has implications for making diagnosis and giving treatment of SLI children.

Hung & Schumacher (2014) found that the (in) animacy of the topic phrase may play a significant role in the processing the topic structures. Therefore, in the future, a more extensive and direct examination of the relationship between animacy and the processing of topic structures is desirable.

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