Taiwan Journal of Linguistics
Vol. 1.1, 111-120,2003
doi:10.6519/TJL.2003.1(1).5

MEMORY CAPACITY IN SCHOOL-AGE MANDARIN-SPEAKING CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT*

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ABSTRACT

Ten school-age Mandarin-speaking children with specific language impairment (SLI) were tested with three memory tasks: (1) a position probe task, (2) a missing object task and (3) a word span task. Two control groups, one age-matched and one language-matched, were also tested. In the three tasks, children with SLI performed significantly poorer than the age-matched controls only in the object position probe task, a test on spatial memory. When compared with the younger language-matched controls, the SLI group performed at the same level in all three tasks. These findings indicated that these school-age children with SLI suffered a deficit in memorizing spatial positions of an array of objects but not in their memory for verbal stimuli. During the experiment, it was also observed that most children, both SLI and normally developing controls, did vocally or sub-vocally rehearse the stimuli in the two spatial memory tasks. Therefore, it is very likely that they had converted the spatial memory tasks into verbal memory tasks and thus the deficit our SLI subjects displayed is still verbal in nature.

1. INTRODUCTION

Children with specific language impairment (SLI) are those who "show a significant limitation in language abilities, yet the factors usually accompanying language problems - such as hearing impairment, low non-verb intelligence test scores and neurological damages-are not

* This study was funded by the National Science Council (NSC 89-2411-H-002-064).

evident" (Leonard 1997). It has also been reported that children with SLI suffered from memory deficits which might contribute to their language problems. SLI children are found to be impaired in recalling word strings (Kail, Hale, Leonard and Nippold 1984) as well as non-words (Gathercole and Baddeley 1990). They were also slower in identifying previously presented verbal stimuli (Stark and Montgomery 1995). These results have led to the hypothesis that SLI children suffer from a limited processing capacity which further affects their language acquisition process (Kail 1994, Gathercole and Baddeley 1993). Opponents of this account argue that the linguistic abilities of the SLI children contribute to their poor performance in processing linguistic materials. Van der Lely and Howard (1993) found no significant differences between younger language-matched (LA) control children and the six-to-nine years old SLI subjects in a series of word span tasks. Their SLI children were equally sensitive to the linguistic characteristics of the experimental stimuli (i.e., word and non-word), and the processing demands imposed by different test paradigms (repetition or picture-pointing).

Kushnir and Blake (1996) questioned the use of language-matched subjects in Van der Lely and Howard's (1993) study. They pointed out that younger children might be developmentally inferior in some other cognitive areas such that their memory span was restricted and thus they were on a par with older SLI subjects. Matching subjects' language abilities could not control all the confounding factors in the word span task. In Kushnir and Blake's own study, SLI children from three to five years old were found to be poorer in word span tasks than control children who were matched by sex, age and non-verbal IQ. Moreover, the performance of the SLI children in the other two spatial memory tasks did not differ from that of their normally developing counterparts. Therefore Kushnir and Blake concluded that sequential verbal memory was critical to language acquisition and was deficient in SLI children.

One of the major differences in the studies between Van der Lely and Howard (1993) and Kushnir and Blake (1996) is in the age of the subjects they tested. Van der Lely and her colleagues tested older SLI subjects, from six to nine years old, while Kushnir and Blake's (1996) subjects were three years younger, from three to five years of age. It is very likely that for children of different ages, the loading of memory tasks varies. For younger children, the task of memorizing words and objects might be a novel one but for older children, it is a common task

they need to handle in everyday school life. Therefore, in the present study we adopted the memory tasks used in Kushnir and Blake's (1996) study to examine the memory capacity of school age Mandarin-speaking children with specific language impairment. Our goal is to examine if similar deficits in sequential verbal memory can be found with our Chinese older SLI subjects, a point which might explain the contrasting results between Van der Lely and Howard (1993) and Kushnir and Blake (1996).

2. METHOD

2.1 Subject

Three groups of children participated in this study. The first group included ten children with specific language impairment, diagnosed and referred by their schools according to their verbal and non-verbal scores on the Wechsler Intelligence Scale for children. Their verbal IQ scores were below 77 while their non-verbal IQ scores were above 85. They were all first graders and in the age range between 6;10 and 7;6. The age-matched (CA) control group was made up of ten normally developing children and the language-matched (LA) control group was ten younger normally developing children with an age range of 5;2 and 5;9. They were matched with the SLI participants according to their scores in the Preschool Language Disorders Test (Lin and Lin 1993).

2.2 Task and Procedure

Participants were tested individually in a quiet room at their schools. They were first tested with the Object Position Probe Task, and the Missing Object Task, and then the Word Span Task.

2.2.1 Object Position Probe Task

A series of animal pictures was shown to the child (see Table 1), one by one. These cards are 10 cm by 7 cm, hand-drawn and colored. After the presentation, each of the picture cards was lined up in a row, face-down. Then a cue card was placed in the middle of the picture row

and the child was asked to find the one that was the same among the cards that were placed face-down. The child was shown the correct card regardless of the correctness of his or her choice. Test trials began with two-picture series after a demonstration with two two-picture sets. Once the child passed three out of a total of five trials, the test moved up to a new level with an additional picture in the series. The task terminated when the child failed to move up to a higher level.

2.2.2 Missing Object Task

A horizontal array of 10 cm by 7 cm, containing hand-drawn colored pictures of different objects was placed in front of the child. One of the pictures was then turned face-down when the whole array was screened. Then the child was asked to name the picture that was turned face-down. Before the task, the child named all the pictures used and substitution was made when the child failed to label the picture. The test trials began with two-picture arrays and once the child passed three out of the five trials, the test moved up to a new level with an additional picture in the array. The task terminated when the child failed to move up to a higher level.

2.2.3 Word Span Task

The child was asked to repeat animal names verbatim and recall had to be in correct order. Test trials began with two names and as in the first two tasks, once the child passed three out of five trials, the test moved up one level with an additional animal name added to the list. The task terminated when the child failed to move up to a higher level.

Table 1 Stimuli in the Three Memory Tasks

Object Position Task	Missing Object Task	Word Span Task	
		Romanization	Gloss
1. corn	1. plane	1. xiao-gou	dog
2. duck	2. car	2. xiao-mao	cat
3. snake	3. scissors	3. xiao-zhu	pig
4. bottle	4. hat	4. xiao-niao	bird
5. sun	5. cup	5. da-xiong	bear
6. ladybug	6. shoe	6. da-xiang	elephant
7. umbrella	7. key	7. qing-wa	frog
8. violin	8. chair	8. lao-shu	mouse
9. tree	9. balloon	9. shi-zi	lion
10. leopard	10. sunglasses	10. jing-yu	goldfish
11. owl	11. watch	11. mu-ni	cow
12. fish	12. pencil	12. hu-die	butterfly
13. snail	13. banana	13. wu-gui	turtle
14. watch	14. computer	14. hai-tun	dolphin
15. frog		15. ban-ma	zebra
16. cucumber		16. qi-e	penguin
17. hat			
18. yacht			
19. kite			
20. zipper			

3. RESULTS

The means and standard deviations of the three memory tasks are listed in Table 2. The CA controls scored highest in all three tasks. The SLI group showed a higher mean score (mean = 4.4) than the language control group (mean = 4.2) in the position probe task but was poorer in both missing object task and word span task. Three one-way ANOVAs were conducted and a significant difference was found in the position

probe task only (F = 3.723, p < .05). Post hoc analyses revealed that in the position probe task, the CA controls did significantly better than the SLI group and the LA group. No significant difference in performance was found between the SLI group and the LA group. In the missing object task, although the CA controls performed better than the SLI group, the difference was not significant.

Table 2. Results of the Three Memory Tasks

Group	Age	Object Position Probe	Missing Object	Word Span
SLI	7;2	4.40 (0.84)	3.50 (1.58)	3.50 (0.85)
LA controls	5;7	4.20 (1.48)	3.60 (1.08)	4.00 (0.82)
CA controls	7;4	5.70 (1.57)	4.70 (2.06)	4.10 (0.74)
Kushnir and Blake (1996)				
Language Impaired	3;10	3.3 (1.0)	3.6 (1.3)	2.1 (0.8)
Controls	3;9	3.7 (1.0)	4.6 (1.2)	3.0 (0.4)

4. DISCUSSION

Our results indicate that the children in the SLI group were on a par with their age controls in the word span task, a finding which appears to be in contrast with the results in Kushnir and Blake's study. However, when the word span of the LA controls is also taken into consideration, such a contrast becomes interpretable. In this study LA controls and CA controls also performed at the same level in the word span task (LA = 4.0, CA = 4.1) while these two groups had an age difference of twenty one months (LA = 5;7, CA = 7;4). Even though there is no norm reference for the word span of these two age groups, one does not expect that verbal memory development halts at age five. It is very likely that for children who are five years of age or older, the memory loading on the word span task is not as heavy as it is on three to four years old children. Since words used in the word span task are names of common animals, older children, both normally developing and with SLI, might be able to memorize them by using other non-verbal cues and thus shifted the

burden of memory to other domains. In other words, the word span task is not an effective measurement for older children. Our argument here is similar to the one put forth by Kushnir and Blake in questioning the appropriateness of using language-matched controls in studying SLI children's memory capacity: other cognitive factors may affect verbal memory development.

While the SLI children in this study did not show any significant deficit in word span, they did poorer than the CA controls in memorizing object positions. This result seems to be contradictory because by definition SLI children should be intact in all cognitive domains except language. There are two possible accounts to this result. First, it has been suggested in the literature that SLI children might suffer from a general cognitive deficit that has somehow escaped the scrutiny of IQ testing (Johnston 1992). Therefore, our results here can to some extend be taken as a support for such a general cognitive view. The second account is based on our observation during the experiment. We found that most of the children, in all three groups, started to vocally or sub-vocally rehearse the names of the animals after one or two trials. We may suppose that our subjects found that their recall in the spatial memory tasks benefited from such rehearsal. In fact, Hitch, Halliday, Schaafstal and Schraagen (1988) found that younger children tend to rely on visual rather than phonological coding. Henry and Millar (1993) pointed that after age seven, an increasing number of children discover and learn to use verbal rehearsal which further increases memory span. Our SLI participants and the CA controls were at this age and probably they had started to make use of verbal rehearsal strategy for any stimuli, both verbal and non-verbal, they need to memorize. What followed in our experiments is simply that the SLI children were less effective in executing the verbal rehearsal task. Between the two types of code, visual and phonological codes, that can be used for memorizing pictures in the position probe task, the SLI children might be deficient in processing the phonological codes. They might have problems converting the forms in the pictures into names, a problem of lexical access which has been reported in the literature (Katz, Curtiss and Tallal 1992; Montgomery, Scudder and More 1990). In other words, the observed deficit in spatial memory in the SLI children's in this study is still verbal in nature.

5. CONCLUSION

In this study we examined the verbal and spatial memory of ten school-aged SLI children. We found that the SLI children did less well than their CA controls in the object position task. Their sequential verbal memory appeared to be normal. When compared when LA controls, SLI children performed at the same level in all three tasks. However, from our observations in the two spatial memory tasks, we found that most participants verbally rehearsed the stimuli and thus it is suggested that SLI children's problem in spatial memory could be a consequence of their problem in lexical access when performing the verbal rehearsal.

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學齡期特定型語言障礙兒童的記憶容量

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本研究以三種不同的實驗作業測試了十位年約七歲的特定型語言障礙（SLI）兒童的記憶容量。作為對比的有兩個控制組：年齡對照組和語言能力對照組。兩個對照組各有十位發展正常的兒童。三個實驗作業分別是：（一)物件位置，（二）物件名稱，（三）語詞記憶。結果發現在三個作業中，SLI 兒童的表現只有在「物件位置」比年齡對照組差，其餘兩個作業沒有顯著的差異。跟語言能力對照組相比，兩組的表現相若。我們的資料顯示這些 SLI 兒童的記憶缺陷是在物件的順序關係而非在處理語音訊息。不過我們也發現在兩個非語言的記憶作業中，大多數的兒童在作業開始後不久，就會低聲唸出眼前物件的名稱。因此兩個空間記憶工作也就摻入了語言的因素。SLI 兒童在物件位置作業中表現不佳，可能是因為他們不能利用口語線索來提昇自己的表現。因此他們的記憶問題仍然與語言有關。