Structural Persistence in Mandarin Chinese Preschoolers

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The phenomenon of structural persistence has been intensively investigated in speakers of English and in speakers of other Germanic languages. However, few studies have been reported on Chinese, especially on preschooler population. In addition, the SVO-*ba* alternation and dative alternation have not been discussed in terms of this perspective. The purpose of this study is to investigate whether Chinese 4- and 5-year-olds can also exhibit this effect in the production-to-production and comprehension-to-production conditions, and whether it is a transient short-term memory effect or an implicit memory/learning effect. 96 preschoolers were tested individually by using the animation depiction paradigm. The results indicated that they also exhibited structural persistence in both conditions. This effect was much stronger in the production-to-production condition, suggesting that Chinese preschoolers' structural persistence was more associated with the cognitive procedures of production. In addition, structural persistence involved a learning process. Structural persistence could be obtained despite the distance across language families.

0. Introduction.

Studies regarding syntactic priming have been conducted intensively over the past twenty years (Bock, 1986). Syntactic priming or structural persistence refers to the phenomenon such that when a speaker comprehends or repeats a sentence, s/he tends to utilize the structure just encountered for the subsequent speech production. For example, a speaker may hear and/or produce a ditransitive sentence such as 'John gave Mary a book' and then sees a picture involving a scene where a bird is sending a letter to a lion. S/he will tend to reproduce the structure just produced to describe this scene as 'A bird is sending the lion a letter' more often than 'A bird is sending a letter to the lion'. If this occurs, the person is syntactically primed. The terms 'structural persistence' or 'syntactic priming' will be used alternatively for subsequent discussion. This phenomenon has been extensively investigated in Germanic languages such as English, Dutch and German. Also, it has been found that structural persistence can occur in a variety of conditions, populations, structures and techniques. Findings from these conditions have demonstrated the multifaceted aspects of syntactic priming. Whenever a different population, different language or different structure is utilized to study syntactic priming, one can uncover different facets of syntactic priming.

However, no studies of syntactic priming in Chinese have been reported or systematically studied. *Ba*-construction has been considered the center of Chinese grammar. The property that it can alternate with the SVO structure in the bounded event can be one of the representative structures in Mandarin Chinese to study the syntactic priming as in (1).

(1) a. Zhangsan ba Lisi tuidaole.   (*ba*-construction)
     Zhangsan Ba Lisi push-down Asp
  b. Zhangsan tuidaole   Lisi.   (SVO structure)
     Zhangsan push-down   Lisi
     Zhangsan pushed-down Lisi.

In addition to this alternation, the Chinese dative alternation, the prepositional dative vs. double object dative, which are parallel to the English counterpart as in (2), will be also employed to investigate a similar issue.

(2) a. Zhangsan songle yiben shu   gei   Lisi.
     Zhangsan gave   CL-a book   to   Lisi
     Zhangsan gave a book to Lisi.
  b.Zhangsan songgeile Lisi yiben   shu.
     Zhangsan gave-to   Lisi CL-a   book
     Zhangsan gave Lisi a book.

The addition of this alternation serves as a replication and comparison for the extensively studied English and Dutch dative alternations. How this effect will be realized and its magnitude is will shed light on the existing syntactic priming literature. Although syntactic priming in current research is defined according to how speakers tend to exhibit this phenomenon either in hearing or hearing and repeating the prime, accounts for syntactic priming are still at issue. One purpose is to investigate under which circumstances syntactic priming will robustly occur. As a result, the production-to-production condition where the speakers comprehend and repeat the prime, and the comprehension-to-production condition where the speakers simply comprehend the prime without repeating it, will be tested. Besides, the durability of the effect of syntactic priming is also of interest in this study.

1.   Experiments for Chinese Preschoolers' Structural Persistence.
The following experiments regarding the priming effects have been conducted with the English-speaking preschoolers of ages from 4;6 to 5;8. Children selected at this age are assumed to have abstract syntactic knowledge (Snedeker & Thorthathiri, 2008), and therefore, results obtained in these studies are less likely to incur debates over whether children have abstract knowledge. Previous experiments with English speakers

have shown that children at this age also manifest syntactic priming effects (Huttenlocher, Vasilyeva, & Shimpi, 2004) in two types of alternations, the active-passive alternation and the dative alternation, in both comprehension-to-production and production-to- production experiments. In addition, several developmental psycholinguists (Savage, et al., 2003) have reported that if younger children such as 3- and 4-year-olds exhibit priming effects only if the prime and the target in the experiments were overlapped significantly, i.e., with identical lexical items, and pronouns occurring in both prime and target, while this effect was found among older children 6-year-olds without high lexical overlap between prime and target. They also reported that 4-year-olds exhibited the syntactic priming effect in the comprehension-to-production condition. Recently, Thorthathiri and Snedeker (2008a; b) reported that English-speaking 3- year-olds exhibited abstract syntactic priming without lexical overlap between prime and target. All these studies argue against the shared-representation account where syntactic priming draws on the different syntactic representations in comprehension and in production but these representations are intricately intertwined and favor the same-representation account where syntactic priming draws on the same syntactic representation in both comprehension and production. However, when scrutinizing these studies, one can see that the robustness of the abstract syntactic priming in the comprehension seems dubious. It seems inevitable to test young children in a short experimental list which includes no fillers and use the face-to-face manipulation, a confederate-scripting-like paradigm for elicitation of syntactic production.

Huttenlocher et al. (2004) arranged the same types of alternations of primes and targets in a block, i.e., active-passive in one block and prepositional dative and double object dative in the other. This arrangement might lead to an accumulation of the priming effect for the alternation. As a consequence, the priming effect is strengthened and occurs in the comprehension-to-production condition. Savage et al. (2003) reported that 4-year-olds exhibited syntactic priming in the comprehension-to-production condition with the high lexical overlap between prime and target. Lexical overlap between prime and target will lead to a lexical boost in the priming effect (Branigan et al. 2000), and Van Gompel and colleagues (2007; 2008) reported that verb repetition between target and prime plays a critical role in the priming effect for comprehension. Thorthathiri and Snedeker (2008a), using the act-out manipulation and dialogue between two participants might induce young children to activate the syntactic rules for the subsequent visual search in a visual word paradigm design. In sum, all these studies employ multiple boosts and manipulations to induce the priming effect occur in comprehension.

Furthermore, it is still unknown whether the priming effects were a transient effect or a long lasting effect for the Chinese preschoolers. The effect of syntactic priming was once considered a transient memory effect (Wheeldon & Smith, 2003), whereas Bock and Griffin (2000) found that structural persistence was an implicit learning process in adults, and Huttenlocher et al. (2004) obtained a similar effect in a preschooler population whereby the priming effect among English preschooler effect could persist over 10

trials without the experimenter's further input of the structure. Savage et al. (2006) reported that English-speaking 4-year-olds can persist in using the previously encountered structure more than 1 week if the children are primed with multiple verbs, i.e., variation in the prime types with reinforcement of the picture description within a 1-week interval. Mandarin-speaking 4- and 5-year-olds should also persist in using the prime after several lags. The priming effect will reflect the learning effects.

The first two studies below were conducted to investigate whether Mandarin-speaking 4- and 5-year-olds exhibit robust and abstract syntactic priming in the two aforementioned alternations in both production-to-production and comprehension-to-production conditions with no lexical overlap between prime and target. Previous studies in Indo-European languages have reported that adult and children speakers manifest the robust priming effects independent of lexical items in the production-to-production experiment, but there exist controversies in comprehension or in the comprehension-to-production condition. The following two experiments utilized the Chinese SVO-*ba* alternation and dative alternation to explore the first three questions below. The third experiment was conducted to investigate the durability of the priming effect.

1. Will the preschoolers at ages 4;6 to 5;8 show priming effects independent of lexical priming in these two alternations?
2. Will structural persistence occur in both from production-to-production and from comprehension-to-production conditions?
3. Will any language specific effects be obtained in the Chinese preschooler population?
4. Will the effect of syntactic priming can persist over a period of time or will it diminish quickly just as a short term memory effect?

1.1 Experiment 1: Chinese Preschoolers' Structural Persistence in the Production to-Production Condition.

Method.

Participants. 32 preschoolers (17 boys and 15 girls) were recruited from two kindergartens from the Zhanghua community with their parents' consents and their assent. Their ages ranged from 4;4 to 5;8 with an average age of 4;11. They were all native speakers of Mandarin Chinese, but 27 of them were also Chinese-Taiwanese bilingual speakers. However, all of them were Mandarin-dominant. All the children in this experiment were very cooperative and all their data were included for analysis. None was excluded for subsequent analysis.

Materials. There were two sets of 16 animations for each sentence type: the SVO and *ba* transitive, and the prepositional and double object datives. One set of the animations either depicted the SVO structure or the S *ba* O V structure, while the other set of animations could be described with the prepositional datives or double object

datives. They were created in Flashplayer 9. Half of each set of the animations, or eight animations were used by the experimenter for his own descriptions and the other eight were used to let the children describe the animations the experimenter presented to them. For example, an animation with a dog moving to hug a cat could be described as *xiaogou baozhule xiao mao*, 'little dog hugged the little cat.' or *xiao gou ba xiamao baozhule*, 'little dog hugged the little cat.' The child also saw different animations which were compatible with both structures.

The eight sets of transitive target animations involve an agent and a patient, both of which are animate. The eight dative set of target animations involve an agent, a theme, and a receiver. The agent and the patient were animate and the theme was an object that could be transferred from the agent to the receiver. For example, one animation showed a dog throwing a ball to a cat and the cat receiving the ball.

Two lists consisting of 32 animations were constructed in order to counterbalance the design. Each animation used to elicit children's production was paired with two primes of different structures in the two lists. No consecutive set of animations involved the same alternation type. That is, what followed the set from one of the transitive structures would be one of the two dative structures but not a set for the other transitive structure.

Procedures. The experimenter visited the kindergarten and the teacher spared a room for the experimenter to interact with the children. The children were tested individually. When the child came to the room, the experimenter first asked the child whether s/he wanted to play an animation description game with the experimenter. If the child said yes, the whole experiment started. The experimenter told the child that s/he would describe the animations in turn, and asked the child to repeat his description before proceeding to describe his/her own animations. The experimenter asked each child the names of the characters in the animation for the first four trials to help them know how to describe the animation. For example, when the animation showed a dog is embracing a cat, the experimenter asked the child the name of characters in Chinese, such as *zhe shi shei*, 'Who is it?' *Na zhi yige you shi shei*, 'this one, who is it?' *Zhe yige dongzuo shi sheme*, 'What is this action called?' Then the experimenter proceeded to ask, *zhige donghua li fasheng le sheme shi*, 'What happened in the animation?' After the child finished describing his/her own animation, the experimenter continued describing his own in turn until the end of all the animations.

Coding and Scoring. Children's descriptions of the animations were coded according to the syntactic structures they produced. A sentence would be coded as an SVO structure if it contained a subject, a verb and an object and would be coded as an S *ba* O V structure if it contained a subject, a *ba* marker, an object and a verb. A sentence would be coded as a prepositional dative if the structure contained a subject, a verb, a theme, a *gei* 'to' word and a recipient and as a double object if the sentence contained a

subject a verb with or without *gei* 'to', depending on the properties of the verb, recipient, and theme. Other sentences did not fall into these categories were coded as 'other'.

Results.

Table 1 displays the raw count and the percentages for the four structures in each priming condition in the production-to-production condition. Table 1 shows the total raw number in that condition and the percentage in parentheses. The results indicate reliable priming effects across both alternations. After the preschooler repeated the prime uttered by the experimenter, they tended to reuse the repeated structure for describing the animations. They tended to use SVO structures more after they repeated an SVO structure, and incidence of SVO transitive in the SVO priming condition increased 18 percent, compared to the *ba* transitive priming condition ($t_{31}=2.30$, p<.05). They also tended to use the *ba* transitive more often after producing the *ba* transitive uttered by the experimenter, and the incidence of the *ba* transitive increased 20 percent in the *ba* transitive priming condition, compared to the SVO transitive priming condition ($t_{31}=2.71$, p<.05). Similarly, the preschoolers tended to reuse the prepositional dative after repeating the prepositional prime uttered by the experimenter, and the incidence of the prepositional dative increased 25 percent in the prepositional dative priming condition ($t_{31}=3.484$, p<.001), compared to the double object dative priming condition. Similar results were obtained for double object dative production. The preschoolers tended to reuse the double object primes after repeating this structure used by the experimenter, and the incidence of the double object dative increased 23 percent in the double object dative priming condition ($t_{31}=4.27$, p<.001), compared to the prepositional dative priming condition.

Table 1. Preschoolers' Syntactic Priming Effect by Sentence Forms: Raw Numbers and Percentages of Utterances for Four Syntactic Forms Following Priming Sentences in Production-to-Production Condition.

Priming Condition	Utterance	Form	
	SVO transitive	BA transitive	Total
SVO transitive	80 (63%)	42 (33%)	122 (95%)
ba transitive	57 (45%)	68 (53%)	125 (98%)
Difference	23 (18%)*	26 (20%)**	
	Prepositional dative	Double object dative	
Prepositional dative	90 (70%)	33 (26%)	123 (96%)
Double object dative	58 (45%)	63 (49%)	121 (95%)
Difference	32 (25%)**	30 (23%)**	

Discussion.

Mandarin-speaking 4- and 5-year-olds exhibited abstract syntactic priming in both Chinese syntactic alternations, the SVO-*ba* and dative alternations in production-to-production priming. Most importantly, Mandarin-speaking preschoolers were primed in the unattested transitive SVO-*ba* alternation. The positive results obtained here contributes further cross-linguistic evidence for an abstract syntactic representation among children of age 4, which allow syntactic priming (Fisher, 2002b; Huttenlocher, Vasilyeva, & Shimpi, 2004; Savage et al., 2003; Snedeker & Thorthathiri, 2008; Tomasello, 2000; 2003).

Preschoolers seem to have no preference for one of the two alternate structures for both alternations in the animation description task. They tended to produce more SVO targets in the SVO priming condition and more *ba* targets in the *ba* construction priming, and similar patterns were obtained for the dative alternation. This indicates two implications. First, the animations were appropriate materials for studying these two alternations. Children showed no priori preference for the animations displayed to them. Second, children may not be entrenched in using one structure to the extent as the adults do. They tended to use the previously produced structure more for subsequent productions. Of course, the explanation of the decreasing the on-line cognitive load is also applicable to this tendency in such a dialogue-like paradigm.

As mentioned earlier, whether children at this age exhibit abstract syntactic priming without the intervention of the potential confounds due to high lexical overlap or other manipulations in comprehension is still at issue. The following experiment is conducted to address this issue.

1.2 Experiment 2: Chinese Preschoolers' Structural Persistence in the Comprehension-to-Production Condition.

This experiment investigated whether the preschoolers in this experiment would manifest priming effects if they did not repeat the prime uttered by the experimenter with no lexical overlap between the prime sentences and target animations.

Method.

Participants. 32 preschoolers (16 boys and 16 girls) were recruited from two kindergartens from the Zhanghua community with their parents' consents and children's assent. Their ages range from 4;6 to 5;8 with an average age of 5;0. They were all native speakers of Mandarin Chinese, but 26 of them were also Chinese-Taiwanese bilingual speakers. Three children did not say anything in the experiment, even though they agreed to play the game: they were replaced with three other children for the experiment.

Materials. The materials were identical to those in Experiment 1.

Procedures. The procedures were almost identical to those in the Experiment 1 except one step. After the experimenter described the animation, i.e., uttering the prime, the child was not asked to repeat what the experimenter said, but directly proceeded to describing his/her own animations.

Coding and Scoring. The coding and the scoring were identical to those in Experiment 1.

Results.

Table 2 displays the raw numbers and percentages for the four structures in each priming condition in the comprehension-to-production condition. The numbers denotes the total raw number in that condition, with percentages in parentheses. The results indicate that reliable priming effects only showed up in the dative alternation. After the preschoolers heard the prime uttered by the experimenter, they tended to reuse the same structure for describing the animations. The preschoolers tended to reuse the prepositional dative after hearing this structure, and the incidence of the prepositional datives increased 21 percent in the prepositional dative priming condition (t_{31}=2.227, p=.033<.05), compared to the double object dative priming condition. The preschoolers tended to reuse the double object dative after hearing this structure, and the incidence of the double object datives was 22 percent greater in the double object dative priming condition (t_{31}=2.143, p=.04<.05) than in the prepositional dative priming condition.

Although preschoolers tended to use the SVO structures more after hearing the SVO structure, and the incidence of the SVO transitives in the SVO priming condition increased 13 percent compared to the *ba* transitive priming condition, the statistics were not reliable (t_{31}=1.559, p=.129>.05). Again, although they also tended to use the *ba* transitive more often after hearing the *ba* transitive, and the incidence of the *ba* transitive increased 14 percent in the *ba* transitive priming condition compared to the SVO transitive priming condition, the statistics were not reliable (t_{31}=1.502, p=.143>.05). Again, children in this experiment did not show any preference for using one of the two alternate structures for the subsequent production.

Compared with the effects in previous study, the priming effect of both alternations seems smaller in this experiment. Furthermore, the SVO-*ba* alternation did not exhibit a reliable priming effect. Altogether, the results indicated that the effects in the comprehension-to-production are smaller or even unreliable, as opposed to those in the production-to-production condition.

Table 2. Preschoolers' Effect of Syntactic Priming for Sentence Forms: Percentages of Utterances for Four Syntactic Forms Following Priming Sentences in the Comprehension-to-Production Condition

Priming Condition	Utterance Form		
	SVO transitive	BA transitive	Total
SVO transitive	74 (58%)	49 (38%)	123 (96%)
Ba transitive	58 (45%)	67 (52%)	125 (98%)
Difference	16 (13%)	18 (14%)	
	Prepositional dative	Double object dative	
Prepositional dative	87 (68%)	31 (24%)	118 (92%)
Double object dative	60 (47%)	59 (46%)	119 (93%)
Difference	27 (21%)*	28 (22%) *	

Discussion.

Unlike the production-to-production experiment, children did not show reliable priming effects for the transitive SVO-*ba* alternation, or showed smaller effect on the dative alternation, though they did produce more previously heard structures for the subsequent animation description. The null effect of the SVO-*ba* alternation should not be attributed to children not having abstract syntactic knowledge. Adults definitely have abstract syntactic knowledge but they do not exhibit any reliable syntactic priming effect with no lexical overlap between target and prime in the comprehension-to-production condition (see this authors' another study in Chinese-speaking adults' syntactic priming). Preschoolers at this age as well as adults may deploy syntax differently in comprehension. This might stem from transitive forms of the SVO-*ba* alternation being more entrenched in their linguistic repertoire, and from being confident and comfortable in using the structure they have in mind without reusing a previously heard structure to decrease the on-line cognitive burden or align the syntactic structure in the dialogue.

In this between subject and dialogue-like manipulation, Chinese preschoolers manifested the reliable effects of structural persistence in the dative alternation, suggesting that Chinese preschoolers were also sensitive to the function of structural persistence in dialogue, i.e., it was a form of alignment in the dialogue to smooth the conversational context for the ongoing dialogue (Ferreira & Bock, 2007; Pickering & Garrod, 2004). Due to this alignment function, structural persistence can take place without repeating the prime. The interlocutors' or respondents' reuse of a previously encountered structure lessened the on-line processing load for subsequent production in the dialogue. In addition, another reason for the preschoolers exhibiting the structural persistence effect may be because it is relatively difficult for them to retrieve a set of multiple syntactic constructions compatible with the animations for subsequent productions with their limited linguistic repertoire in such a short time.

However, the asymmetry of the transitive vs. dative alternations that have been found in the literature (Bock, 1986; Bock & Griffin, 2000; Branigan et al., 2000; Hartsuiker & Kolk, 1999) suggest that the dative alternation seems to be more sensitive to the syntactic priming than the transitive alternation in English, Dutch and now in Mandarin Chinese. The effect of syntactic priming may be construction-sensitive or due to the more restricted structural distributions of the syntactic alternations (Bock et al., 2007).

These effects are incompatible with the previous English-based studies showing preschoolers exhibit reliable and abstract syntactic priming effects in the comprehension-to-production condition (cf. Vasilyeva, & Shimpi, 2004; Savage et al., 2003). Preschoolers as well as adults deployed syntax differently in the production-to-production and comprehension-to-production conditions. They showed robust and abstract syntactic priming effects in the former condition, but the effect may not be robust in the latter condition. The results are compatible with the shared-representation account rather than the same-representation account.

1.3 Experiment 3: Durability of Preschoolers' Syntactic Priming.
Method.

Participants. 32 preschoolers (16 boys and 16 girls) were recruited from two kindergartens from the Zhanghua community with their parents' consents and their assent. Their ages ranged from 4;6 to 5;8 with an average age of 5;1. They were all native speakers of Mandarin Chinese, but 26 of them were also Chinese-Taiwanese bilingual speakers. However, all of them were Mandarin-dominant. All the children in this experiment were very cooperative and all their data were included for analysis. None was excluded for subsequent analysis.

Materials. These were identical to those used in the previous experiments.

Procedures. The children were tested individually. When the child came to the room, s/he was asked whether s/he wants to play a game with the experimenter. If s/he said yes, the experiment began. The child was told that s/he and the experimenter would describe a set of eight animations in turn. After the experimenter finished describing his own set of eight animations, the child proceeded to depicting her/his own set of eight animations. For example, after the experimenter used the S *ba* O V structure to describe his own sets, he asked the children to describe their own sets. Each child was asked to describe one set of transitive animations and one set of dative animations from one of the four lists employed to counterbalance the design.

Scoring. This was identical to the previous two experiments.

Results.

Table 3 displays the raw count and the percentages for the four structures in each priming condition in the production-to-production condition. Table 3 shows the total raw number in that condition and the percentage in parentheses. The results indicate reliable priming effects across both alternations. After the preschooler heard the prime with a lag of eight trial uttered by the experimenter, they tended to reuse the structure of the prime to describe their own set of the animations. They tended to use SVO structures more after they repeated an SVO structure, and incidence of SVO transitive in the SVO priming condition increased 26 percent, compared to the *ba* transitive priming condition (t_{30}=2.803, p<.05). They also tended to use the *ba* transitive more often after producing the *ba* transitive uttered by the experimenter, and the incidence of the *ba* transitive increased 26 percent in the *ba* transitive priming condition, compared to the SVO transitive priming condition (t_{30}=3.230, p<.05). Similarly, the preschoolers tended to reuse the prepositional dative after hearing the prepositional prime with an eight-trial lag uttered by the experimenter, and the incidence of the prepositional dative increased 17 percent in the prepositional dative priming condition (t_{30}=2.225, p<.05), compared to the double object dative priming condition. Similar results were obtained for double object dative production. The preschoolers tended to reuse the double object primes after hearing this structure used by the experimenter, and the incidence of the double object dative increased 17 percent in the double object dative priming condition (t_{30}=2.223, p<.05), compared to the prepositional dative priming condition.

Table 3. Preschoolers' Syntactic Priming Effect by Sentence Forms: Raw Numbers and Percentages of Utterances for Four Syntactic Forms Following Priming Sentences in the Experiment of the Durability of Effect of Syntactic Priming.

Priming Condition	Utterance	Form	
	SVO transitive	BA transitive	Total
SVO transitive	88 (69%)	34 (27%)	122 (95%)
ba transitive	55 (43%)	68 (53%)	123 (96%)
Difference	33 (26%)*	34 (26%)*	
	Prepositional dative	Double object dative	
Prepositional dative	75 (59%)	48 (38%)	123 (96%)
Double object dative	54 (42%)	71 (55%)	125 (98%)
Difference	21 (17%)*	23 (17%)*	

Discussion.

Whether the effect of syntactic priming reflects a learning process or is a short-term memory effect was controversial in the literature. Wheeldon and Smith (2003) reported that when there is one irrelevant trial/filler intervening between the prime and

the target, the effect disappears. However, Bock and Griffin (2000) and Bock et al. (2007) found that the effect of syntactic priming can persist over a lag of ten filler trials and even more the magnitude was comparable between 0 lag and 10 lag in both production-to-production and comprehension-to-production experiments. Huttlencholer et al. (2004) and Savage et al. (2006) found a similar long-lasting effect of syntactic priming. The former found that English-speaking 4- and 5-year-olds can endure over 10 trials while the latter found that this effect can persist over weeks if the children are reinforced. The finding from this experiment suggests that the effect of syntactic priming reflects a learning process. Chinese-speaking children as well as English-speaking children exhibit long lasting effect in the Chinese SVO-*ba* alternation and dative alternations. Taken together, these studies suggest that types of construction do not impose an impact on the durability of the syntactic priming effect.

2. General Discussion and Concluding Remarks

The three experiments above were conducted primarily to explore the four questions proposed in Section 2.0. The results from the experiments 1 provide us with evidence that Chinese 4- and 5-year-olds exhibit robust and abstract syntactic priming in production-to-production condition from the SVO-*ba* alternation and dative alternation. This finding is compatible with a great number of findings from studies in Germanic languages such as Dutch and English in the adult population (Bock, 1986; Bock & Loebell, 1990; Bock et al., 1992; Hartsuiker & Kolk, 1998 and many others). It is also provides a new piece of evidence that preschoolers at this age exhibit robust and abstract syntactic priming in a language from English (Huttelocher et al., 2004; Savage et al., 2003). However, the results from the experiment 2 draw a different picture from English studies. Chinese-speaking preschoolers did not consistently exhibit robust and abstract syntactic priming in the comprehension-to-production condition. No reliable effect of syntactic priming was found in the transitive SVO-*ba* alternation in contrast to the dative alternation. This finding contradicts the representational account or the same representation account that syntactic priming draws on the same syntactic representation common for both comprehension and production (Branigan et al., 2000; Chang et al, 2007) but favors a shared-representation account on syntactic priming. This asymmetric finding between SVO-*ba* alternation and dative alternation suggests that syntactic priming may be construction/alternation sensitive. For several conditions, the internal difference between these two alternations will be reflected in the syntactic priming.

Nonetheless, the interpretation and the findings should be cautious at this moment. From Table 2, it is found that there is a trend that Chinese-speaking preschoolers tend to reuse the previously heard structure for the subsequent animation description, though it does not reach the reliable statistics. A reasonable conjecture can be inferred that if more children are tested in this experiment, a reliable statistical effect can be obtained in the transitive SVO-*ba* alternation. Therefore, the interpretation of the experiment two should be withheld to some extent.

The experiment three reports the fact that Chinese-speaking preschoolers also exhibit long-lasting syntactic priming, suggesting that syntactic priming involves the learning mechanism. The activation of the syntactic structures makes adaptation to the learning system which would adjust itself with the incoming experience, leading to learning or a long lasting effect. This hypothesis has been simulated in Chang et al.'s (2007) computational model.

These three experiments add new pieces of evidence to the multifaceted syntactic priming that syntactic priming can be robustly occur in spite of the distance across different language families. The properties we discuss so far seem to be parallel to the procedural memory in the literature. The findings suggest that this effect goes beyond short-term memory and have the characteristics of implicit learning.

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