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Priming Effects of Hierarchical Graphics on Chinese Ambiguous Structures

Tao Zeng[1, 2, *], Yarong Gao[1], Xiaoya Li[1]

[1]College of Foreign Languages, Hunan University, Changsha, China
[2]Hunan Provincial Research Center for Language and Cognition, Changsha, China

Abstract

Inspired by the researches concerning structural priming across cognitive domains, this study investigated the priming effects from hierarchical graphics to Chinese structures. Unlike syntactic priming, structural priming refers to the tendency to repeat or process a current sentence better due to its structural similarity to the previously experienced "prime", which can be abstract structures and even independent of language, as long as the prime and the target share some aspects of abstract structural representation. Since both abstract graphics and specific structures share similar hierarchical structures, this research conducted the priming experiment with eye tracking technique to verify structural priming effects from hierarchical graphics to Chinese ambiguous structures. The study adopted the sentence comprehension task through EyelinkII which covered two variant ambiguous structures: *Quantifier* + NP_1 + *De* + NP_2 and NP_1 + *Kan/WangZhe* + NP_2 + *AP*. There were 24 sets of materials and every set contained three priming hierarchical graphics and a target sentence. The priming conditions were high-attachment prime condition, low-attachment prime condition and baseline prime condition respectively. The target sentences were ambiguous, for example, *liangge xuesheng de jiazhang* 'two parents of the students' or 'two students' parents'. Then, a question followed, for example, *xuesheng jiazhang de shuliangshi*? 'What is the number of parents?' The different choice representing different comprehension of the target sentence, for choice A was *liangge* 'two' resulting from high-attachment comprehension, while choice B was *buqueding* 'uncertain' resulting from low-attachment comprehension. The comprehension task aimed to verify whether the structure of hierarchical graphics affected the tendency of target sentences comprehension. Results showed that there is priming effect from abstract graphics to Chinese ambiguous structures according to behavioral data and eye movement pattern, which indicated that hierarchical graphics and language shared similar structural representations.

Keywords

Hierarchical Graphics, Chinese Ambiguous Sentence, Structural Priming, Structural Representation

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1. Introduction

Structural repetition is normal in our daily life and people may repeat the structure which they have just encountered unconsciously. The previous experience of 'prime' structure can facilitate the comprehension or production of the subsequent 'target' structure, which is called structural priming. Structural priming has been under scrutiny in recent years, ever since the classic and influential experiment conducted by Bock [1], who used picture description task to prove the existence of structural priming among native speakers. Inspired by Bock, a large number of researchers have done much research related to structural priming [2-5].

In some cases, structural priming has been seen as syntactic priming [6-8], but the prime of structural priming can be abstract structure and even independent of language. So far,

* Corresponding author
E-mail address: taozengclarry@hnu.edu.cn (Tao Zeng)

studies related to structural priming across domains have been conducted by a series of researchers including music and language [9], math and language [10], and sequential processing and language [11]. Researchers made some explorations of abstract priming and found effects of structural priming from non-linguistic hierarchical structure, specifically math to language [12-14].

Meanwhile, many accounts have been put forward to explain structural priming. There are two alternative hypotheses about the mechanisms behind the structural priming, namely 'Residual Activation Account' [15] and 'Implicit Learning' [16]. The former model claims that priming is attributed to the activation in a particular memory location or representation. The latter model accounts for the structural priming in terms of learning process and claims that the structural process is normally unconscious. However, Scheepers [9] found that neither 'Activation Account' nor 'Learning Account' could well explain the priming of relative clause attachment and thus raised new doubts. Then, Scheepers [12] put forward 'Representational Account' and 'Incremental-Procedural Account'. The former account assumes that people retain global structural representations of equations and sentences in working memory, as long as high-attachment and low-attachment structures are not differentiated by local structure. The latter account relies on the sequence of processing, which assumes that the computation of a mathematical expression, like the sentence reading, proceeds from left to right in most cases. In this way, the priming can occur between mathematics and language. These findings challenge existing theories of priming and provide new evidence for the domain generality of structure.

Based on the previous studies, we chose hierarchical graphics as the prime, and selected Chinese ambiguous structures 'Quantifier + NP1 + De + NP2' and 'NP1 + Kan/WangZhe + NP2 + AP' as the target, to explore the structural priming effect from hierarchical graphics to Chinese ambiguous structures. Three research questions are as follows:

Are the repriming effects across cognitive domains between abstract graphics and Chinese ambiguous structures?

What are the characteristics of eye movements in processing high-attachment sentences and low-attachment sentences under three prime conditions?

Does abstract graphics and language share similar structural representations?

In this paper, two ambiguous Chinese structures '*Quantifier + NP1 + De + NP2*' and '*NP1 + Kan/WangZhe + NP2 + AP*' were selected. The ambiguity of the first structure '*Quantifier + NP1 + De + NP2*' is due to the '*Quantifier*', which can not only modify '*NP1*', but also modify '*NP2*'. This structure is exemplified in sentence (1). The quantifier *liangge* 'two' can modify *NP1 jiazhang* 'parents', meaning like (1a) and forming high-attachment. Besides, *liangge* 'two' can also modify *NP2 xuesheng* 'students' like (1b) and forming low-attachment. The other structure '*NP1 + Kan/WangZhe + NP2 + AP*' is also ambiguous, which is the result of bi-directional orientation of *AP*, for it not only can be oriented to *NP1*, but also *NP2*, (2) set a good example for this structure. The *AP huanhuqueyue* 'jumped for joy' can be oriented to *NP1 kantaiguanzhong* 'spectators in the bleachers', meaning like (2a) and forming high-attachment. Furthermore, *AP huanhuqueyue* 'jumped for joy' can also be oriented to *NP2 shengli duiwu 'winning team'*, meaning like (2b) and forming low-attachment.

(1)

Liangge xuesheng de jiazhang laidao xuexiao jinxing tousu.
Two students DE parents come to school make a complaint

a. 'Two parents of the students came to school and made a complaint.'

b. 'Two students' parents came to school and made a complaint.'

(2)

Kantai guanzhong wangzhe shengli duiwu huanhuqueyue.
Bleachers spectators watch winning team jump for joy

a. 'Spectators in the bleachers watched the winning team and jumped for joy.'

b. 'Spectators in the bleachers watched that the winning team jumped for joy.'

Similarly, hierarchical graphics are able to form similar hierarchical structure with '*Quantifier + NP1 + De + NP2*' and '*NP1 + Kan/WangZhe + NP2 + AP*', as shown in the followings. Figure 1 shows both high-attachment (the left panel) and low-attachment graphics (the right panel) of the first structure '*Quantifier + NP1 + De + NP2*'. Figure 2 illustrates both high-attachment (the left panel) and low-attachment graphics (the right panel) of the second structure '*NP1 + Kan/WangZhe + NP2 + AP*'.

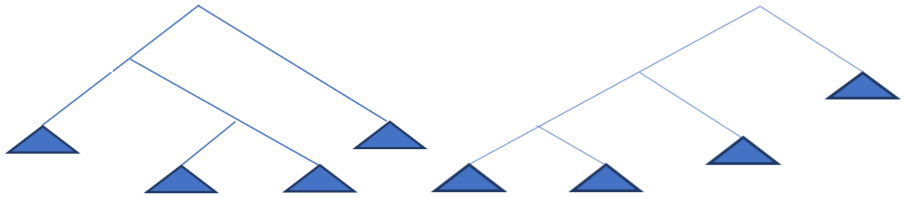


Figure 1. HIERARCHICAL STRUCTURE OF GRAPHICS OF SENTENCE 1.

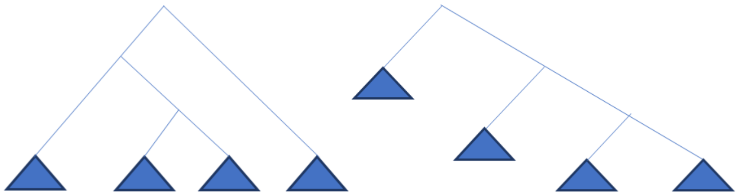


Figure 2. HIERARCHICAL STRUCTURE OF GRAPHICSOF SENTENCE 2.

The above figures show that high-attachment graphics are similar to high-attachment sentences (1a; 2a). Low-attachment graphics (Figure 1, right; Figure 2, right) share similarities with low-attachment sentences (1b; 2b).

(1a)

Liangge xuesheng de jiazhang laidao xuexiao jinxing tousu.
two students DE parents come school make a complaint
Quantifier NP1 NP2

(1b)

Liangge xuesheng de jiazhang laidao xuexiao jinxing tousu.
two students DE parents come school make a complaint
Quantifier NP1 NP2

(2a)

Kantai guanzhong wangzhe shengli duiwu huanhuqueyue.
bleachers spectators watch winning team jump for joy
NP1 NP2 AP

(2b)

Kantai guanzhong wangzhe shengli duiwu huanhuqueyue.
bleachers spectators watch winning team jump for joy
NP1 NP2 AP

2. Method

2.1. Participants

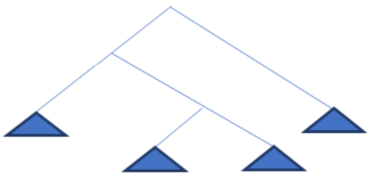
The participants were 40 graduate students of Hunan University with an average age of 24. All of them were Chinese native speakers. The reasons why they were chosen as the participants were as follows. Firstly, the subjects had normal eyesight or corrected eyesight, which ensured that they could follow the black spots' movement on the screen. This was essential to carry out the experiment. Secondly, they were all adults rather than teenagers, who were more patient to sit before the screen and persisted in finishing the long-time experiment. In sum, the participants selected could be supposed to be appropriate subjects in the present study.

2.2. Materials

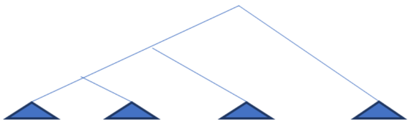
For the sake of accessibility of target sentences, 20 students who did not participate in formal experiments carried out a proper evaluation of the sentences before the experiment was conducted. The purpose was to get rid of the irrational sentences and make the experimental materials more reasonable. Experimental materials were mainly materials of sentence comprehension task, which included two ambiguous structures

‘*Quantifier* + NP_1 + *De* + NP_2’ and ‘NP_1 + *Kan/WangZhe* + NP_2 + *AP*’. There were 24 sets of materials such as (3) and (4) in the sentence comprehension task, whereas every set contained three hierarchical graphics and a target sentence. The hierarchical graphics were high-attachment graphics, low-attachment graphics and baseline graphics, respectively. The different choice representing different comprehension of the target sentence, for choice A was normally high-attachment comprehension, while choice B was generally low-attachment comprehension. The choice was paired with one of the three graphics to form different prime-target pairs. (5) and (6) presented two ways of comprehension, either high-attachment comprehension like (5a) and (6a) or low-attachment comprehension like (5b) and (6b).

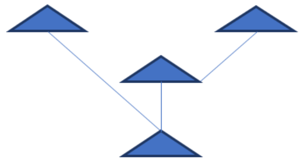
(3) High-attachment prime:



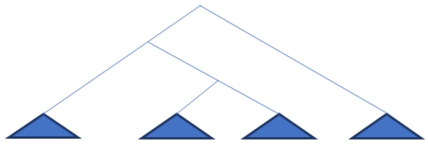
Low-attachment prime:



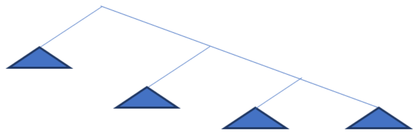
Baseline prime:



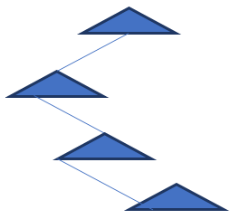
(4) High-attachment prime:



Low-attachment prime:



Baseline prime:



(5)

Liangge xuesheng de jiazhang laidao xuexiao jinxing tousu.
two students parents come to school make a complaint.

a. [Liangge [xuesheng de jiazhang]$_{NP}$]$_{QP}$ laidao xuexiao jinxing tousu.
‘Two parents of the students came to school and made a complaint.’

b. [[Liangge xuesheng]$_{QP}$ de jiazhang]]$_{NP}$ laidao xuexiao jinxing tousu.
‘Two students’ parents came to school and made a complaint.’

(6)

Kantai guanzhong wangzhe shengli duiwu huanhuqueyue.
Spectators in the bleachers watch winning team jump for joy.

a. [[Kan tai guanzhong wangzhe sheng li duiwu]$_{CP}$ huanhuqueyue]CP.
‘Spectators in the bleachers watch the winning team and jump for joy.’

b. [Kan tai guanzhong wangzhe[shengli duiwu huanhuqueyue]CP]CP.
‘Spectators in the bleachers watch that the winning team jump for joy.’

The examples of abstract graphics were listed in (3) and (4). All of the graphics were followed by simple questions to make sure that participants had read them carefully. The questions mainly covered these three aspects. Firstly, how many elements are there in the graphics? Secondly, how many lines are there in the graphics? Thirdly, what is the shape of the element? Following these questions, two different choices were provided. In order to reduce difficulty in answering questions, the questions were quite easy for participants. The baseline primes were graphics without hierarchy, which were easy to process.

In the sentence comprehension task, the target structures were ambiguous structures that could be processed in two ways. The first ambiguous structure was ‘*Quantifier* + NP_1 + *De* + NP_2’, consisting of a quantifier, two nouns and a *de*. The example was shown in (5). Because the ambiguity of the sentence resulted from the 'Quantifier', 'Quantifier' has therefore become the key of comprehension. The 'Quantifier' can modify not only 'NP_1', but also 'NP_2'. If the participants thought that the quantifier *liangge* 'two' modified NP_1 *jiazhang* 'parents' meaning like (5a), it is a high-attachment structure. If the participants think that *liangge* 'three' modifies NP_2 *xuesheng* 'students' meaning like (5b), it is a low-attachment structure. Another ambiguous structure was '*NP1 + Kan/WangZhe + NP2 + AP*' which includes two nouns, a verb and an AP. The ambiguity of the structure results from the bi-directional orientation of *AP*, which can be oriented to not only NP_1, but also NP_2. (6) sets an example for this structure. If participants believe that the *AP huanhuqueyue* 'jump for joy' is oriented to NP_1 *kantaiguanzhong* 'spectators in the bleachers', the meaning may refer to high-attachment like (2a). If the participants believe that the *AP huanhuqueyue* 'jump for joy' is oriented to NP_2 *shengliduiwu 'winning team'*, the sentence may indicate low-attachment meaning like (2b).

2.3. Procedures

Pretest The whole experiment was made up of three main steps. Firstly, 24 sets of materials of each structure were designed for the experiment, which was paired to form high-attachment, low-attachment and baseline conditions. In this way, participants comprehended 48 sets of materials under three conditions. In order to make sure that the participants would not notice the target sentences, we inserted 26 structurally unrelated fillers in each structure including 13 graphics and 13 sentences in a random order. When designing the experiment, we presented 3 fillers in the beginning and put 1 filler before every prime-target pair. Hence, every participant processed 48 sets of prime-target pairs and 52 fillers of two structures.

Stimuli The eye movement experiment was launched as designed. Eye-Link 1000 plus was adopted as the experiment instrument to record and collect participants' behavioral data and eye movements. At first, the subjects were directed to be seated in front of the Eye-Link computer approximately 75cm from the monitor, and their heads were supported by a chin rest to minimize head movements. Secondly, in order to ensure the accuracy of eye movement tracking, instrument calibration was carried out. Thirdly, after the calibration procedure, the experimental part started, which included practice trials to ensure that participants became familiar with the experiment procedure and got used to reading materials presented on the screen. Before the experiments, the experimenters explicitly explained the rules about the experiment to participants, and asked every participant to pre-test the practical experiment. The participants were required to read the materials displayed on the computer screen and to make a reaction about the questions following the graphics and sentences by pressing the designed keys 'J' and 'K' on the computer keyboard. At the beginning of each trial, participants were asked to focus on a black fixation point that appeared against a white background towards the left of the screen. Once they fixated on the black dot, experimenters pressed keyboard on the host computer to start the experiment. When they finished reading the material and understood its meaning, they needed to press the keyboard rapidly to make a reaction. All the materials were presented in a fixed order. In every set, the first screen was hierarchical graphics; the second screen was simple questions about the graphic and answers to choose; the third screen was ambiguous sentence; and the last screen was questions with regard to the sentence and answers to choose. In addition, all the participants were separated from each other to avoid being interrupted by others so as to ensure the fluency of the whole experiment and the accuracy of data collection.

3. Results

This part presented and analyzed all the data collected from experiments, which included both behavioral data and eye movement statistics. As three interest areas were set in each ambiguous structure, analysis of eye movement statistics were based on the data from these interest areas.

3.1. Behavioral Data

Test of Kruskal-Wallis was applied in order to verify whether there were priming effects in sentence comprehension task. The results illustrated that there was a significant difference of priming effect among three prime conditions (baseline prime, high-attachment prime and low-attachment prime) in two ambiguous structures, regardless of the comprehension tendency (high-attachment comprehension, low-attachment comprehension).

Speaking of the ambiguous structure '*Quantifier* + NP_1 + *De* + NP_2', when prime conditions were changed, both the proportion of high-attachment comprehension and of low-attachment comprehension showed a big difference (high-attachment comprehension: X^2=10.52, p=.01; low-attachment comprehension: X^2=17.28, p=.00<.001). In this structure, there was a tendency of high-attachment comprehension. Even in baseline prime condition, the proportion of high-attachment comprehension reached 57%. Under the condition of high-attachment priming, the low-attachment tendency droppedwhile the high-attachment comprehension increased from 57% to 83%. However, under the condition of low-attachment priming, there was a decrease of high-attachment comprehension and an increase of low-attachment comprehension from 43% to 45%.

In terms of the other structure 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*', there was a dramatic difference of comprehension performance under three different prime conditions (high-attachment comprehension: X^2=21.89, p=.00<.001; low-attachment comprehension: X^2=22.01, p=.00<.001). As for this structure, no preference for high-attachment comprehension or low-attachment comprehension was detected. It can be seen that the proportion of high-attachment comprehension and low-attachment comprehension was 48% and 52% respectively under baseline prime conditions. Under the condition of high-attachment priming, high-attachment comprehension increased radically from 48% to 75%. Meanwhile, under the condition of low-attachment priming, there was a low-attachment comprehension preference with an increase from 52% to 70%.

Table 1. Results of Performance in Sentence Comprehension Task.

Comprehension Results	Prime Conditions	*Quantifier* + NP_1 + *De* + NP_2	NP_1 + *Kan/WangZhe* + NP_2 + *AP*
High-attachment Comprehension	Baseline Prime	57%	48%
	High-attachment Prime	83%	75%
	Low-attachment Prime	55%	30%
	Total	65%	51%
Low-attachment Comprehension	Baseline Prime	43%	52%
	High-attachment Prime	17%	25%
	Low-attachment Prime	45%	70%
	Total	35%	49%

Note: *p<.05; **p<.01; ***p<.001

3.2. Eye Movements of Structure '*Quantifier* + NP_1 + *De* + NP_2'

Three interest areas were set in the structure '*Quantifier* + NP_1 + *De* + NP_2' to fully observe and analyze participants' eye movements while processing high-attachment sentence fragments and low-attachment sentence fragments. The whole ambiguous fragment '*Quantifier* + NP_1 + *De* + NP_2' was taken as an interest area while other interest areas were based on the comprehension tendency. 'NP_2' was set as an interest area in high-attachment comprehension, whereas'NP_1' was regarded as an interest area in low-attachment comprehension. Specific eye movement statistics of interest area '*Quantifier* + NP_1 + *De* + NP_2'were shown below in Table 2.

Table 2. Eye Movement of Interest Area '*Quantifier* + NP_1 + *De* + NP_2'.

Comprehension Results	Prime Conditions	DT (ms)	FRDT (ms)	SRDT (ms)	RPD (ms)	FC
High-attachment Comprehension	Baseline Prime	1418.6	986.3	432.2	1419.4	8.3
	High-attachment Prime	1203.2	811.5	391.7	1204.1	5.8
	Low-attachment Prime	1383.7	966.5	417.2	1386.5	8.1
Low-attachment Comprehension	Baseline Prime	1595.4	1162.5	432.9	1597.2	8.5
	High-attachment Prime	1588.3	1143.1	445.2	1591.5	8.2
	Low-attachment Prime	1398.5	983.4	415.1	1399.3	6.2

Note: DT - Dwell time; FRDT - First Run Dwell Time; SRDT - Second Run Dwell Time; RPD - Regression Path Duration; FC - Fixation Count;*p<0.05, **p<0.01.

As shown in Table 2, there were five eye movement indexes of the structure '*Quantifier* + NP_1 + *De* + NP_2' in three prime conditions. When participants took the structure as high-attachment, in the high-attachment prime condition, they spent the least time comprehending the ambiguous structure and paid the fewest fixations among three prime conditions (DT: 1203.2; FRDT: 811.5; SRDT: 391.7; RPD: 1204.1; FC: 5.8). While in baseline prime conditions, the statistics of five eye movement indexes were the largest among three prime conditions (DT: 1418.6; FRDT: 986.3; SRDT: 432.2; RPD: 1419.4; FC: 8.3). One-way ANOVA tests were conducted to compare each index between high-attachment prime condition and baseline prime condition, and the effects were significant (DT: F=25.6, **p=.00<.01, η^2=.32; FRDT: F=22.3, **p=.00<.01, η^2=.35; SRDT: F=105.5, *p=.02<.05, η^2=.19; RPD: F=23.5, **p=.00<.01, η^2=.36; FC: F=47.4, **p=.00<.01, η^2=.26). Then in low-attachment prime conditions, the figures of eye movement indexes were between high-attachment prime conditions and baseline prime conditions (DT: 1383.7; FRDT: 966.5; SRDT: 417.2; RPD: 1386.5; FC: 8.1). According to a series of AVOVA tests, there was no significant difference between eye movement indexes in low-attachment prime condition and those in baseline prime condition.

When participants regarded the structure as low-attachment, the pattern of eye movement in the three prime conditions was totally different. In low-attachment condition, participants took the smallest time to process the ambiguous structure and paid the least fixation count among three prime conditions (DT: 1398.5; FRDT: 983.4; SRDT: 415.1; RPD: 1399.3; FC: 6.2). However, in baseline prime condition, participants spent the most time and paid the most fixation count (DT: 1595.4; FRDT: 1162.5; SRDT: 432.9; RPD: 1597.2; FC: 8.5). Based on a series of ANOVA tests, there were significant differences of four eye movement indexes in the two prime conditions except second run dwell time (DT: F=22.5, **p=.00<.01, η^2=.37; FRDT: **F=21.2, p=.00<.01, η^2=.33; RPD: **F=25.5, p=.00<.01, η^2=.56; FC: **F=41.4, p=.00<.01, η^2=.2). With regard to the eye movement indexes in the high-attachment prime condition, the figures were close to the indexes in baseline prime condition (DT: 1588.3; FRDT: 1143.1; SRDT: 445.2; RPD: 1591.5; FC: 8.2). After ANOVA tests, there was no difference of any index between these two conditions.

As the '*Quantifier*' can modify both 'NP_1' and 'NP_2', the ambiguous structure '*Quantifier* + NP_1 + *De* + NP_2' could be comprehended in two ways. When subjects took it as a high-attachment one, the '*Quantifier*' modifies 'NP_2'. In this way, 'NP_2' was set as another interest area to observe and analyze participants' eye movements, and the analyses of related indexes were presented below in Table 3.

The eye movements of interest area 'NP_2' was set in three prime conditions. When subjects comprehended the ambiguous structure as high-attachment, in high-attachment prime condition, the shortest time was taken and most fixation count was paid (DT: 341.2; FRDT: 218.6; SRDT: 127.6; RPD: 408.9; FC: 3). While in baseline prime condition, participants spent the most time and paid the least fixation count (DT: 415.8; FRDT: 233.7; SRDT: 182.1; RPD: 473.8; FC: 2.2). Significant differences of eye movement indexes were found between these two prime conditions except the first run dwell time (DT:**F=32.5, p=.00<.01, η^2=.4; SRDT: **F=75.8, p=.00<.01, η^2=.51; RPD:**F=21.3, p=.00<.01, η^2=.32; FC: **F=38.6, p=.00<.01, η^2=.29). As for the eye movement in low-attachment prime condition, the figures were close to eye movement indexes in baseline prime condition (DT: 403.5; FRDT: 226.9; SRDT: 176.6; RPD: 465.5; FC: 2.4). Furthermore, no significant difference of any index was found in these two conditions.

When the subjects comprehended the structure as low-attachment, in the low-attachment prime condition, they spent the shortest time and paid the most fixation count (DT: 308.6; FRDT: 216.5; SRDT: 92.1; RPD: 469.3; FC: 2.5). On the contrary, in the baseline prime condition, the figures of eye movement indexes were the largest except fixation count (DT: 386.3; FRDT: 223.1; SRDT: 163.2; RPD: 554.6; FC: 2.3). Significant differences of eye movement indexes were found between these two prime conditions except the first run dwell time and fixation count (DT:**F=36.7, p=.00<.01, η^2=.34; SRDT: **F=157.3, p=.00<.01, η^2=.6; RPD:**F=15.3, p=.00<.01, η^2=.19). In the high-attachment prime condition, the pattern of eye movements was similar with eye movements in the baseline prime condition (DT: 375.7; FRDT: 219.6; SRDT: 156.1; RPD: 528.5; FC: 2.4). In addition, there was no significant difference of any index between these two prime conditions.

Table 3. Eye Movement of Interest Area 'NP_2'.

Comprehension Results	Prime Conditions	DT (ms)	FRDT (ms)	SRDT (ms)	RPD (ms)	FC
High-attachment Comprehension	Baseline Prime	415.8	233.7	182.1	473.8	2.2
	High-attachment Prime	341.2	218.6	127.6	408.9	3
	Low-attachment Prime	403.5	226.9	176.6	465.5	2.4
Low-attachment Comprehension	Baseline Prime	386.3	223.1	163.2	554.6	2.3
	High-attachment Prime	375.7	219.6	156.1	528.5	2.4
	Low-attachment Prime	308.6	216.5	92.1	469.3	2.5

Note: DT - Dwell time; FRDT - First Run Dwell Time; SRDT - Second Run Dwell Time;
RPD - Regression Path Duration; FC - Fixation Count; *p<0.05, **p<0.01.

When the subjects took the ambiguous structure '*Quantifier* + NP_1 + *De* + NP_2' as a high-attachment one, the '*Quantifier*' modifies 'NP_1'. Therefore, 'NP_1' was set as another interest area to observe and analyze participants' eye movements, and the analyses of related indexes were given below in Table 4.

Table 4 illustrated the pattern of eye movements which were in interest area '*NP1*' in three prime conditions. When it comes to high-attachment comprehension, participants used the least time and paid the least fixation count in the high-attachment prime condition (DT: 363.7; FRDT: 219.5; SRDT: 144.2; RPD: 389.4; FC: 2.1). While in baseline prime condition, participants took the least time to process the interest area and the fixation count was between the other two prime conditions (DT: 432.6; FRDT: 225.4; SRDT: 207.2; RPD: 452.3; FC: 2.3). There were significant differences between these two prime conditions except first run dwell time and fixation count (DT:**F=26.7, p=.00<.01, η^2=.24; SRDT: **F=137.6, p=.00<.01, η^2=.53; RPD:**F=21.3, p=.00<.01, η^2=.18). The pattern of eye movements in the low-attachment prime condition was similar with that in the baseline prime condition (DT: 451.5; FRDT: 221.6; SRDT: 229.9; RPD: 479.5; FC: 2.5). No significant difference was found of any index between these two prime conditions.

Table 4. Eye Movement of Interest Area 'NP_1'.

Comprehension Results	Prime Conditions	DT (ms)	FRDT (ms)	SRDT (ms)	RPD (ms)	FC
High-attachment Comprehension	Baseline Prime	432.6	225.4	207.2	452.3	2.3
	High-attachment Prime	363.7	219.5	144.2	389.4	2.1
	Low-attachment Prime	451.5	221.6	229.9	479.5	2.5
Low-attachment Comprehension	Baseline Prime	483.6	241.6	242	505.1	2.2
	High-attachment Prime	492.5	238.7	253.8	499.4	2.4
	Low-attachment Prime	395.4	223.3	172.1	431.5	2.8

Note: DT - Dwell time; FRDT - First Run Dwell Time; SRDT - Second Run Dwell Time;
RPD - Regression Path Duration; FC - Fixation Count; *p<0.05, **p<0.01.

As for low-attachment comprehension, the figures of four indexes concerning time were the smallest and the fixation count was the largest in low-attachment prime condition (DT: 395.4; FRDT: 223.3; SRDT: 172.1; RPD: 431.5; FC: 2.8). The eye movements in the baseline prime condition and in high-attachment prime condition showed similar pattern. The dwell time and second run dwell time in baseline prime condition was 483.6ms and 242ms, which was slightly shorter than that in high-attachment prime condition (DT: 492.5; SRDT: 253.8). While the first run dwell time and regression path duration in baseline prime condition (FRDT: 241.6; RPD: 505.1) was a little longer than that in high-attachment prime condition (FRDT: 238.7; RPD: 499.4). In addition, the fixation count in baseline prime condition and in high-attachment prime condition was 2.2 and 2.4, respectively. There were significant differences between low-attachment prime condition and baseline-prime condition except first run dwell time (DT:**F=32.6, p=.00<.01, η^2=.35; SRDT: **F=104.9, p=.00<.01, η^2=.48; RPD:**F=19.8, p=.00<.01, η^2=.21; FC: **F=28.5, p=.00<.01, η^2=.27). Furthermore, no significant difference was detected between high-attachment prime condition and baseline prime condition.

3.3. Eye Movements of Structure 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*'

There were three different interest areas that were set in the structure 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*'. These interest areas were used to observe and analyze participants' eye movements while they were processing high-attachment sentence fragments and low-attachment sentence fragments. First of all, the whole ambiguous sentence 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*' was set as an interest area. Then, as '*AP*' was able to modify either 'NP_1' or 'NP_2', other interest areas were based on the comprehension tendency. With high-attachment comprehension, 'NP_1' was taken as an interest area. While with low-attachment comprehension, 'NP_2' was set as an interest area. The eye movement data of interest area '*Quantifier* + NP_1 + *De* + NP_2'were shown below in Table 5.

Table 5. Eye Movement of Interest Area 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*'.

Comprehension Results	Prime Conditions	DT (ms)	FRDT (ms)	SRDT (ms)	RPD (ms)	FC
High-attachment Comprehension	Baseline Prime	2086.4	1607.2	479.2	2090.5	13.1
	High-attachment Prime	1750.3	1293.5	456.8	1758.6	10.5
	Low-attachment Prime	2014.7	1586.9	427.8	2023.8	12.7
Low-attachment Comprehension	Baseline Prime	2153.9	1686.4	467.5	2161.8	13.9
	High-attachment Prime	2140.7	1603.2	537.5	2150.3	13.3
	Low-attachment Prime	1832.6	1411.5	421.1	1833.5	10.8

Note: DT - Dwell time; FRDT - First Run Dwell Time; SRDT - Second Run Dwell Time;
RPD - Regression Path Duration; FC - Fixation Count; *p<0.05, **p<0.01.

Table 5 showed the eye movement statistics of interest area 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*'in the three prime conditions. When participants regarded the structure as high-attachment, in high-attachment prime condition, they took the shortest time to process the ambiguous structure and paid the least fixation except second run dwell time (DT: 1750.3; FRDT: 1293.5; SRDT: 456.8; RPD: 1758.6; FC: 10.5). While in baseline prime condition, there was a different picture, since all of the indexes were the largest among three prime conditions (DT: 2086.4; FRDT: 1607.2; SRDT: 479.2; RPD: 2090.5; FC: 13.1). Based on a series of ANOVA tests, there were significant differences between these two prime conditions except second run dwell time (DT:**F=22.1, p=.00<.01, η^2=.31; FRDT: **F=38.5, p=.00<.01, η^2=.45; RPD:**F=30.5, p=.00<.01, η^2=.43; FC: **F=41.5, p=.00<.01, η^2=.36). Then in low-attachment prime condition, the figures of each index was similar with that in baseline prime condition (DT: 2014.7; FRDT: 1586.9; SRDT: 427.8; RPD: 2023.8; FC: 12.7).

When it comes to low-attachment comprehension, shortest time was taken and least fixation was paid in low-attachment prime condition (DT: 1832.6; FRDT: 1411.5; SRDT: 421.1; RPD: 1835.5; FC: 10.8). While in baseline prime condition, participants took the longest time to process and paid the most fixation except second run dwell time (DT: 2153.9; FRDT: 1686.4; SRDT: 467.5; RPD: 2161.8; FC: 13.9). According to

ANOVA tests, significant differences were found between these two prime conditions (DT:**F=31.6, p=.00<.01, η^2=.44; FRDT: **F=27.6, p=.00<.01, η^2=.26; SRDT: **F=74.9, p=.00<.01, η^2=.38; RPD:**F=23.9, p=.00<.01, η^2=.33; FC: **F=121.3, p=.00<.01, η^2=.56). With regard to high-attachment prime condition, the figure of each index was similar with that in baseline prime condition except second run dwell time (DT: 2140.7; FRDT: 1603.2; SRDT: 537.5; RPD: 2150.3; FC: 13.3). After a series of ANOVA tests, only second run dwell time in high-attachment prime showed significant difference from that in baseline prime condition (SRDT: **F=43.2, p=.00<.01, η^2=.19).

As the '*AP*' was able to modify both 'NP_1' and 'NP_2', there are two ways to comprehend the ambiguous structure 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*'. When subjects took it as a high-attachment one, the '*AP*' modifies 'NP_1'. Under this circumstance, 'NP_1' was set as another interest area to observe and analyze participants' eye movements. The analyses of related indexes are listed below in Table 6.

Table 6. Eye Movement of Interest Area 'NP_1'.

Comprehension Results	Prime Conditions	DT (ms)	FRDT (ms)	SRDT (ms)	RPD (ms)	FC
High-attachment Comprehension	Baseline Prime	609.4	341.5	267.9	487.6	2.4
	High-attachment Prime	512.3	356.4	155.9	463.5	3.3
	Low-attachment Prime	587.6	361.8	225.8	449.1	2.3
Low-attachment Comprehension	Baseline Prime	603.6	360.3	243.3	459.8	2.3
	High-attachment Prime	589.7	354.9	234.8	432.6	2.2
	Low-attachment Prime	509.2	345.7	163.5	431.7	2.2

Note: DT - Dwell time; FRDT - First Run Dwell Time; SRDT - Second Run Dwell Time;
RPD - Regression Path Duration; FC - Fixation Count;*p<0.05, **p<0.01.

Table 6 showed the eye movement data of interest area 'NP_1' in three prime conditions. As for high-attachment comprehension, subjects spent the shortest time processing the sentence fragment and paid the most fixation except the first run dwell time and regression path duration (DT: 512.3; FRDT: 356.4; SRDT: 155.9; RPD: 463.5; FC: 3.3). While in baseline prime condition, the figures of five indexes were the largest among three prime conditions except first run dwell time and fixation count (DT: 609.4; FRDT: 341.5; SRDT: 267.9; RPD: 487.6; FC: 2.4). According to ANOVA tests, significant differences were found between these two prime conditions except first run dwell time and regression path duration (DT:**F=27.8, p=.00<.01, η^2=.25; SRDT: **F=152.6, p=.00<.01, η^2=.51; FC: **F=52.4, p=.00<.01, η^2=.31). Then in low-attachment prime condition, the eye movement pattern was quite similar with that under baseline prime condition except second run dwell time (DT: 587.6; FRDT: 361.8; SRDT: 225.8; RPD: 449.1; FC: 2.3). The figure of second run dwell time in baseline prime condition was 42.1 more than that in low-attachment prime condition.

As to low-attachment comprehension, in low-attachment prime condition, shortest time was taken and least fixation was paid among three prime conditions (DT: 509.2; FRDT: 345.7; SRDT: 163.5; RPD: 431.7; FC: 2.2). However, in baseline prime condition, figures of five indexes were the largest among three prime conditions (DT: 603.6; FRDT: 360.3; SRDT: 243.3; RPD: 459.8; FC: 2.3). Based on a series of ANOVA tests, there were significant differences between low-attachment condition and baseline prime condition except first run dwell time, regression path duration and fixation count (DT:**F=43.6, p=.00<.01, η^2=.35; SRDT: **F=129.4, p=.00<.01, η^2=.62). When it comes to high-attachment prime condition, the eye movement pattern was similar with baseline prime condition (DT: 589.7; FRDT: 354.9; SRDT: 234.8; RPD: 432.6; FC: 2.2). No significant difference was reported between these two prime conditions.

When subjects regarded it as a low-attachment structure, the '*AP*' modifies 'NP_2'. In this case, 'NP_2' was set as another interest area to observe and analyze participants' eye movements. The related indexes of eye movement are listed below in Table 7.

Table 7 showed the eye movement data of interest area 'NP_2' in three prime conditions. When participants took the structure as a high-attachment one, in high-attachment prime condition, they took the shortest to process the ambiguous fragment and paid the most fixation (DT: 526.5; FRDT: 359.6; SRDT: 166.9; RPD: 612.3; FC: 2.2). While in baseline prime condition, participants took the longest time to process and paid the least fixation except regression path duration (DT: 634.6; FRDT: 371.2; SRDT: 263.4; RPD: 697.8; FC: 2.1). After a series of ANOVA tests, significant differences were found between these two prime conditions except first run dwell time and fixation count (DT:**F=59.8, p=.00<.01, η^2=.41; SRDT: **F=153.7, p=.00<.01, η^2=.56; RPD:**F=28.3, p=.00<.01, η^2=.32). Then in low-attachment prime condition, participants showed similar dwell time, first run dwell time, second dwell time, regression path duration and the same fixation count with that in baseline prime condition (DT: 615.7; FRDT: 367.8; SRDT: 247.9; RPD: 698.5; FC: 2.1). No significant difference was reported between these two prime conditions.

Table 7. Eye Movement of Interest Area *'NP_2'*.

Comprehension Results	Prime Conditions	DT (ms)	FRDT (ms)	SRDT (ms)	RPD (ms)	FC
High-attachment Comprehension	Baseline Prime	634.6	371.2	263.4	697.8	2.1
	High-attachment Prime	526.5	359.6	166.9	612.3	2.2
	Low-attachment Prime	615.7	367.8	247.9	698.5	2.1
Low-attachment Comprehension	Baseline Prime	611.4	372.3	239.1	687.9	2.4
	High-attachment Prime	582.6	358.9	223.7	658.5	2.3
	Low-attachment Prime	508.7	347.5	161.2	676.4	3.4

Note: DT - Dwell time; FRDT - First Run Dwell Time; SRDT - Second Run Dwell Time; RPD - Regression Path Duration; FC - Fixation Count; *p<0.05, **p<0.01.

When participants comprehended the ambiguous structure as a low-attachment one, under low-attachment prime condition, they spent the shortest time processing the fragment and paid the most fixation among three prime conditions except regression path duration (DT: 508.7; FRDT: 347.5; SRDT: 161.2; RPD: 676.4; FC: 3.4). On contrary, in baseline prime condition, longest time was consumed among three prime conditions and the fixation count was close to that in high-attachment prime condition (DT: 611.4; FRDT: 372.3; SRDT: 239.1; RPD: 687.9; FC: 2.4). According to ANOVA tests, there were significant differences between the indexes in low-attachment prime condition and baseline prime condition except first run dwell time and regression path duration (DT:**F=49.7, p=.00<.01, η^2=.35; SRDT: **F=231.7, p=.00<.01, η^2=.49; FC: **F=82.5, p=.00<.01, η^2=.43). Then in high-attachment prime condition, participants showed similar eye movement pattern with that in baseline prime condition (DT: 582.6; FRDT: 358.9; SRDT: 223.7; RPD: 658.5; FC: 2.3). No significant difference was reported between these two prime conditions.

4. Discussion

4.1. Priming from Hierarchical Graphics to Chinese Ambiguous Structures

Scheepers et al. was the first one who took mathematical equations as 'prime' and proved that priming effects existed from math to language. According to his experiment, math equations exhibiting high-attachment or low-attachment structure could effectively prime equivalent high versus low relative clause attachment in the written completion of sentence fragments. Additionally, Scheepers and Sturt showed that the priming effects could be bi-directional, including effects from math to language and from language to math [17]. Zeng et al. also found that there were priming effects from equations to Chinese ambiguous structure *'NP_1 + You + NP_2 + Hen + AP'*. Furthermore, Van and Hartsuiker applied the paradigm of structural priming attachment and found structural priming from music to language [18]. The research could possibly provide evidence of shared mental representation between language and other cognitive domains, such as mathematics, music, etc.

Inspired by these studies, this study intended to extend in this field and investigate the priming effects across cognitive domains. The goal of this study was to investigate the question of whether complex cognitive systems that exhibit hierarchical structure share mechanisms for structural representation and processing. Motivated by the previous studies suggesting that math, an experiment was designed to test the hypothesis that high-attachment and low-attachment hierarchical graphics can prime similar structures in language.

According to the analyses of behavioral data and eye movement data, both of them served as strong support for structural priming effects from hierarchical graphics to two Chinese ambiguous structures (*Quantifier* + NP_1 + *De* + NP_2; NP_1 + *Kan/WangZhe* + NP_2 + *AP*). The existence of such priming effects would suggest that structural processing mechanisms are indeed shared by these different systems, and any other cognitive domain that possesses hierarchical structure.

In the first place, participants inclined to comprehend the ambiguous structure '*Quantifier* + NP_1 + *De* + NP_2' as a high-attachment one, which may be possibly the result of unbalance of the meanings of ambiguous structures. According to these studies, different ambiguous structures gave people variant senses of ambiguousness. Some interpretations were strong, while the other interpretations were relatively weak. In another word, there was bias of one certain meaning instead of the other meaning. Consequently, the bias of high-attachment interpretation of the structure '*Quantifier* + NP_1 + *De* + NP_2' led to high proportion of high-attachment comprehension, even in baseline-prime condition. Even though *Quantifier* can modify either NP_1 or NP_2, subjects preferred to take *Quantifier*as a modifier of NP_2. In this research, when prime conditions were changed, both the proportion of high-attachment comprehension and low-attachment comprehension showed a significant difference. Consequently, it can be assumed that there were priming effects from hierarchical graphics to Chinese structure '*Quantifier* + NP_1 + *De* + NP_2'. However, with regard to the ambiguous structure 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*', no bias of high-attachment interpretation or low-attachment interpretation was shown by subjects. In this way, high-attachment prime condition improved high-attachment comprehension. Meanwhile, low-attachment prime condition increased the preference for low-attachment comprehension. Hence, behavioral data provided evidence of priming effects across cognitive domains.

In addition, eye movement pattern of two structures also provided strong evidence of priming effects from hierarchical graphics to Chinese ambiguous structures. Previous studies have adopted eye tracking technology to study priming effect and found out that priming effects could facilitate target sentence processing [19-21]. The related eye movement data of five indexes were compatible with findings of the previous studies. The five indexes of eye movement adopted in this experiment were: first run dwell time, second run dwell time, regression path duration, dwell time and fixation count. First run dwell time is a good index to reflect information processing at the early stage, while second run dwell time, regression path duration and dwell time were able to mirror the process of target sentence at the late stage. In addition to these four indexes of time, fixation count could show cognitive load of information processing. Since the eye movements of the two ambiguous structures (‘*Quantifier* + NP_1 + *De* + NP_2’ and ‘NP_1 + *Kan/WangZhe* + NP_2 + *AP*’) were similar, these two structures will be discussed together. On the one hand, the time spent on the interest area was reduced including first run dwell time, second run dwell time, regression path duration as well as dwell time when the prime condition was consistent with comprehension tendency compared with baseline prime condition. This fact indicates that no matter whether it is at the early stage of information process or at the late stage of information process, priming effects quickened the pace of information processing and lowered the difficulty of processing. On the other hand, the fixation count was also greatly decreased when the hierarchical graphics were structurally consistent with the ambiguous sentence compared with baseline prime condition, which suggests priming effects were able to reduce the cognitive load of processing the sentence.

In sum, both the behavioral data and eye movement data supported that there was structural priming effects from hierarchical graphics to Chinese ambiguous structures. This study also provided evidence of shared mental representation between language and other cognitive domains.

4.2. Eye Movement Patterns of Chinese Ambiguous Structures

Five eye movement indexes were selected to observe participants’ eye movement patterns in three prime conditions, which included dwell time, first run dwell time, second run dwell time, regression path duration and fixation count. Then, three interest areas were set to fully compare eye movements of certain ambiguous sentence fragment under high-attachment comprehension and low-attachment comprehension. As two ambiguous structures ‘*Quantifier* + NP_1 + *De* + NP_2’and ‘NP_1 + *Kan/WangZhe* + NP_2 + *AP*’ were adopted in this research, the analyses of corresponding pattern would be discussed separately.

To start with, three interest areas of ‘*Quantifier* + NP_1 + *De* + NP_2’represented different comprehension tendencies. The whole ambiguous fragment ‘*Quantifier* + NP_1 + *De* + NP_2’ was taken as an interest area. As *quantifier* is able to modify both NP_1 and NP_2, with high-attachment comprehension, ‘NP_2’ is taken as an interest area. While with low-attachment comprehension, ‘NP_1’ is set as an interest area. When it comes to the interest area ‘NP_2’ under high-attachment comprehension, subjects tended to spent less time to process the ambiguous fragment and paid more attention to the interest area in high-attachment prime condition, compared with that under baseline prime condition. This suggested that when the prime condition was consistent with comprehension tendency, participants showed a more efficient eye movement pattern. When we took a look at the interest area ‘NP_1’ under low-attachment comprehension, the eye movement pattern was quite similar. Less first run dwell time, second run dwell time, dwell time, as well as regression path duration were spent in the interest area, while more fixation count was paid compared with that in baseline prime condition.

Secondly, the eye movement pattern of ambiguous structure ‘NP_1 + *Kan/WangZhe* + NP_2 + *AP*’ would be analyzed. Different from the former structure, this ambiguous structure is a sentence rather than a sentence fragment. Meanwhile, three interest areas are displayed in this structure including the whole ambiguous sentence ‘NP_1 + *Kan/WangZhe* + NP_2 + *AP*’, sentence fragments ‘NP_1’ and ‘NP_2’. As ‘*AP*’ isable to modify either ‘NP_1’ or ‘NP_2’, based on the comprehension tendency, ‘NP_1’ and ‘NP_2’ were set as two different interest areas respectively. With high-attachment comprehension, ‘NP_1’ was taken as an interest area. While with low-attachment comprehension, ‘NP_2’ was set as an interest area. With regard to the interest area ‘NP_1’, dwell time and second run dwell time dropped greatly while fixation count increased sharply in high-attachment prime condition when participants regarded the structure as a high-attachment one. In another word, priming effects fasten information processing at the late stage and arouse the attention of the participants to the interest area. However, there was no significant difference between these two prime conditions considering the index of regression path duration. That may be the result of the position of the ‘NP_1’, for it was at the beginning of the structure and there was no interest area before the ‘NP_1’. Thus, the regression path duration was similar under any prime condition. Then, when it comes to the interest area 'NP_2' under low-attachment comprehension, the eye movement pattern was quite similar. Less second run dwell time and dwell time were spent in the interest area, while more fixation count was paid compared with that in baseline prime condition.

It can be seen that eye movement patterns of two structures shared some similarities, while had some differences. There may be some theoretical reasons behind the phenomenon, which would be specifically discussed in the following section.

4.3. Priming Effects of Hierarchical Graphics on Chinese Ambiguous Structures

Scheepers at al. find cross-domain priming effects from equations to linguistic expressions and put forward Representational Account to explain the effects. Representational Account claimed that high-attachment and low-attachment structures are not distinguished by purely local structure and people must retain global structural representations of equations and sentences in working memory. The present research has provided evidence for Representation Account, for there was shared structural representation between hierarchical structure and language. The analyses of ambiguous structures '*Quantifier* + NP_1 + *De* + NP_2' and 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*' would be presented below.

Speaking of the structure '*Quantifier* + NP_1 + *De* + NP_2', the ambiguity resulted from *quantifier*, for it canmodify either NP_1 or NP_2. If *quantifier* modifies NP_1, it forms low-attachment. On the contrary, if *quantifier* modifies NP_2, it forms high-attachment. The priming conditions were high-attachment hierarchical graphics and low-attachment hierarchical graphics. From both behavioral data and eye movement data, there were priming effects between hierarchical graphics and language. With regard to the structure 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*', since *AP* can be the modifier of either NP_1 or NP_2, *AP* leads to the ambiguity of the structure. If *AP* modifies NP_1, it forms high-attachment. On the contrary, if *AP* modifies NP_2, it forms low-attachment. Like the former structure, there was strong evidence to support the priming effects across cognitive domains. From these two structures, it was suggested that when subjects processed priming hierarchical graphics, they would process the target sentence in similar ways. Based on Representation Account, hierarchical graphics and linguistics structures are processed as isomorphic at certain level of abstraction.

This study has provided the evidence that two popular mechanisms of priming could not explain structural priming across cognitive domains, which also supported the findings of Scheepers [9]. In addition, the task and instrument adopted in the research are efficient, offering a selection for further studies. What's more, there are some implications for research orientation.

In the first place, the findings of the study had implications for the mechanisms of structural priming. In terms of the Activation Account, structural priming results from the activation of combinatorial nodes. However, the Procedural Account put forward by Scheepers claimed that it cannot account for relative clause attachment (RC) priming, for RC attachments concerned the issue of hierarchical syntactic configuration. Then, with regard to the Implicit Learning Account, structural priming is a long-term effect. On the contrary, Scheepers found it was a short-term effect. Then, Scheepers put forward the Representational Account and the Incremental-Procedural Account [12]. The Representational Account assumes that people retain global structural representations of equations and sentences in working memory. The Incremental-Procedural Account relies on the sequence of processing. Taken together, these two accounts have explained the structural priming between mathematics and language. In this study, two Chinese ambiguous structures were adopted including '*Quantifier* + NP_1 + *De* + NP_2' and 'NP_1 + *Kan/WangZhe* + NP_2 + *AP*'. Our results indicate that there were structural priming effects from hierarchical graphics to Chinese ambiguous structures, which was in line with the findings of Scheepers. The results have shown that neither the Activation Account nor the Learning Account can well explain the structural priming across cognitive domains.

Secondly, the task and instrument used in the present study had some implications for further studies. The comprehension task was useful for ambiguous target sentences by offering two choices representing high-attachment and low-attachment, which can be used in other structural priming studies targeting ambiguous sentences. Furthermore, eye tracker is a useful and helpful instrument to record on-line data when participants are processing the target sentences. This instrument promotes the accurateness and on-line control of the whole study, which canalso be applied to further priming studies.

Lastly, this study also implicated the orientation of further studies. This study has employed hierarchical graphics as primes and ambiguous Chinese sentences as targets, which provided an idea that further studies could use other abstract structures to explore structural priming across cognitive domains. Meanwhile, eye tracker is adopted to record on-line responses of the subjects in the present study. Thus, more on-line instruments can be employed in further research such as ERP.

5. Conclusion

This research has suggested that 1) There is priming effect from abstract graphics to Chinese ambiguous structures

(*Quantifier* + NP_1 + *De* + NP_2; NP_1 + *Kan/WangZhe* + NP_2 + *AP*) on the basis of behavioral data as well as eye movement pattern and the structure of hierarchical graphics can affect the tendency of target sentences comprehension, which suggest that the complex cognitive systems exhibiting hierarchical structure share mechanisms for structural representation and processing; 2) Eye movement pattern is influenced by priming effects. The time spent on the whole interest area was reduced when the prime condition was consistent with comprehension tendency compared with baseline prime condition. While the fixation count was also greatly decreased when the hierarchical graphics were structurally consistent with the ambiguous sentence compared with baseline prime condition; 3) The Representational account was able to explain the structural priming effects from hierarchical graphics to Chinese ambiguous structures, however, the results did not provide positive evidence for Activation Account and the Learning Account.

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