THE ROLE OF PROCESSING STRATEGIES IN CHINESE*

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In psycholinguistics, great efforts have been made to discover the nature of the mental representations and the cognitive operations and computations (Libben, 1996). Some psycholinguists (e. g., Kimball, 1973; Prideaux & Baker, 1986) suggest that language users employ a set of cognitive strategies (Bever, 1970; Kimball, 1973; Slobin, 1973; Slobin & Bever, 1982; Prideaux & Baker 1986) in language processing. Directed by functional oriented approaches, research has been conducted to examine the roles that processing strategies play in language comprehension. Much of this research work focuses on a number of processing strategies such as Closure, Markedness. Generally the proposed processing strategies have been supported.

Previous research was mainly based on Indo-European language data to explore the nature of processing strategies. If the strategies are universal as they are claimed to be, more languages with structures different from Indo-European languages should be tested. Chinese is quite different from English in structures such as the flexibility of word order (Chang, 1992; Lin, 2001), the position of relative clauses. However, few investigations have been searched for processing strategies in Chinese syntax. It is not very clear whether these strategies are operative in Chinese processing. Motivated by this research question, this study aims at testing the roles of two processing strategies: Closure and Markedness in Chinese language. Closure and Markedness are perhaps the best known and best understood of a number of processing strategies proposed.

1. Processing Strategies

A cognitive processing strategy is defined by Prideaux and Baker (1986:26-27) as "a procedure" "which a language user employs as he processes language, during which he attempts to construct a meaning representation". A cognitive processing strategy is grounded on a cognitive make-up of the language user and thus could be considered as universal. Strategies are based on cognitive constraints such as short term memory limitations, attention focuses and relative expectedness of structures.

Closure (e. g., Bever, 1970; Slobin, 1973; Slobin & Bever, 1982; Prideaux & Baker, 1986) is motivated by working memory limitations. In language processing, the language user attempts to close a unit (e, g. phrase, clause) as early as possible. A unit which resists early closure is harder to process than one which allows early closure. A non-interrupted sentence is easier to comprehend than the one which is interrupted internally because a non-interrupted sentence allows early closure.

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The following examples from both English and Chinese are provided to illustrate the distinction of interruption and non-interruption of relative clauses which have become the main structure to test Closure.

Examples from English:

(1) a. He met the neighbor [who sold his car].
S V O Relative Clause (RC)
(non-interruption)

b. The neighbor [whom he met] sold his car.
S RC V O
(interruption)

Examples from Chinese:

(2) a. [Ta jiandao de] nawei linju maidiaole qiche.
[He met (RC marker)] the neighbor sold car.
RC S V O
'The neighbor whom he met sold his car.'
(non-interruption)

b. Ta jiandaole [maidiao qiche de] nawei linju.
He met [sold his car (RC) marker] the neighbor
S V RC O
'He met the neighbor who sold his car.'
(interruption)

Two important structural differences between English and Chinese should be noticed. One difference concerns relative pronouns and the other is about the positions of relative clauses. English relative clauses have overt relative pronouns except that, when the pronoun is the object, the relative pronouns can be optionally deleted. However, Chinese relative pronouns must be obligatorily deleted from the relative clause. As for the positions, English relative clauses follow the modified nouns, whereas Chinese relative clauses must precede their head nouns, indicated by the overt relative marker '*de*'. Obviously, both English and Chinese have interrupting relative clauses. In English, an interrupting relative clause modifies the subject of the main clause, while in Chinese, it modifies the object. In this study, I select Chinese syntactic structures different from those in English to test Closure and Markedness and expect to gain cross-linguistic evidence to support or reject these strategies.

Why is it harder to process an interrupted clause (sentence)? It is mainly due to memory limitations. When processing an interrupted clause, processing on the main clause must be suspended and placed in a memory file while the subordinate clause is dealt with, and then processing the main clause is resumed. Such a memory store is not required when processing a non-interrupted clause, because language users are able to close the first clause and then incorporate it into the second clause.

Markedness (e. g. , Prideaux & Hogen, 1993; Steriade, 1995) is based on relative expectedness of structures. The language user assumes that the unit being processed is in its normal (unmarked) form unless it is marked to the

contrary. In syntax, clauses in normal word orders are easier to process than those in marked word orders. The following examples from both English and Chinese are illustrations of syntactic normal and marked distinctions:

Examples from English:

(3) a. He has sold that old car.
(normal word order: SVO)

b. That old car he has sold.
(marked word order: OSV)

Examples from Chinese:

(4) a. Ta maile naliang jiu qiche.
He sold that-classifier old car
He has sold that old car.
(normal word order: SVO)

b. Ta ba naliang jiu qiche maile.
He (ba-object marker) that-classifier old car sold.
He has sold that old car.
(marked word order: SOV)

c. Naliang jiu qiche ta maile.
That-classifier old car he sold.
That old car he has sold.
(marked word order: OSV)

The normal word order in both English and Chinese in SVO, however, Chinese has relatively free word order (Chang, 1992). Basically, English allows one kind of object preposing: OSV, while Chinese permits two kinds: SOV and OSV. SOV is triggered by the overt object marker '*ba*' in Chinese. A literal English translation of '*ba*' would be 'hold, grasp', although it is generally best left untranslated. According to Chu (1983) and Liu (1991), the '*ba*' construction in Chinese is a unique form in the sense that no other languages have been found to have a structure with the same functions as the '*ba*' construction. The basic form of '*ba*' structure is represented as S *ba* NP V. The NP between '*ba*' and V can be interpreted as the object of V and accordingly can be regarded as a preposed object.

In both English and Chinese, sentences (a) in the above examples are expected to be easier to process than their marked counterparts. The unmarked (normal) structures tend to have less presupposition and are relatively more frequent and more expected. Obviously, there are special circumstances in which the marked forms are used (Prideaux & Hogen, 1993). But such circumstances are more specific and more presuppositional.

There is one study (Yin et. el, 2004) which suggests that Closure is operative in Chinese tri-morphemic compound processing. Tri-morphemic compounds can be either left-branching or right-branching. Quite often tri-morphemic compounds consist of a compound of two morphemes and a third morpheme. When a bi-morphemic compound is further compounded with and

precedes a single morpheme left-branching will be resulted in, this kind of compound allows early closure as in (5).

(5) a. kuai-can dian
fast-meal store
'fast-food restaurant'

b. zi-xing che
self-run vehicle
'bicycle'

On the other hand, when a single morpheme is compounded with and precedes a bi-morphemic compound the string of three characters will result in right-branching. In that case, the first morpheme and second morpheme can not form a compound and early Closure is violated as in (6).

(6) a. bai ji-dan
'white chicken-egg'

b. he qian-ting
nucleus dive-boat
'nuclear submarine'

An on-line lexical decision task was conducted to test the processing strategy: Closure (Yin et. el, 2004). In this study, response times for left-branching compounds which allow early Closure, were shorter than those for right-branching compounds which violate early Closure. This suggests that processing tri-morphemic compounds of left-branching is really easier than processing those of right-branching. The results indicate that compounds which allow early Closure requires less cognitive processing efforts. Yin et. el (2004) suggest that when processing left-branching tri-morphemic compounds the third morpheme can be easier to be attached to the existing structure (the bi-morphemic compound on the left). It does not need any element to be kept in the memory file while the whole compound is processed and the third morpheme is incorporated into the smaller (embedded) compounds on the left naturally. However, when processing tri-morphemic compounds of right-branching, since the first two morphemes cannot form a unit the incorporation of the first morpheme into a larger compound must be suspended and its information must be placed in a memory file while the smaller (embedded) compound (the second and third morpheme) is dealt with, and then the incorporation is resumed. Such a memory store is not required when processing left-branching tri-morphemic compounds which allow early Closure.

In Yin et. el' study (2004), Closure is operative in Mandarin Chinese morphological processing. Is it the case that Closure also operative in Mandarin Chinese syntactic processing? In order to examine the roles Closure and Markedness play in Mandarin Chinese syntactic processing, a relative acceptability judgment experiment was conducted. The two hypotheses to be tested are the following:

Hypothesis One

According to Closure, a non-interrupted clause is easier to comprehend than the one which is interrupted because a non-interrupted clause allows early closure.

Hypothesis Two

According to Markedness, a clause in an unmarked (normal) word order is easier to process than one which is in a marked word order because a clause in a normal word order is more expected and more frequent.

2. Experiment

A relative acceptability judgment study was conducted to test the effects of Closure and Markedness in Mandarin Chinese processing. Most psycholinguists have assumed that judgments of relative acceptability can be influenced by processing factors (e. g. Prideaux & Baker, 1986). According to this assumption, naturalness and acceptability judgments vary with relative processing ease if other things are equal. The more difficult a sentence is to process, the less acceptable it will be judged.

2.1 Participants

The participants were 15 native Chinese speakers studying at the University of Alberta. The participants were non-linguistics majors and volunteered to participate in this study.

2.2 Stimuli

The sentence types to be tested in this experiment are (1) Non-interruption with normal word order; (2) Non-interruption with marked word order; (3) Interruption with normal word order. In this study, Closure will be tested by varying RC (relative clause) structures according to the location of the RC in the matrix clause. Quite different from English, Chinese RC should precede its head noun. If the RC modifies the object NP, it interrupts the main clause. If the RC modifies the subject NP, it allows early closure. Markedness will be tested according to word order in the matrix clause which contains an RC. In Mandarin Chinese, an object can be preposed to the preverbal position triggered by the object marker-*ba* to form a marked structure. The following examples are the illustration of the sentence types used to test the two syntactic processing strategies: Closure and Markedness in this experiment.

(7)	[Ta jiandao de]	nawei	linju	maidiaole	qiche.
	[He met (RC marker)]	the	neighbor	sold	car.
	RC	S		V	O

'The neighbor whom he met sold his car.'
(non-interruption & normal word order)

(8) [Ta jiandao de] nawei linju ba qiche maidiaole.
[He met (RC marker)] the neighbor (ba) car sold.
RC S O V
'The neighbor whom he met sold his car.'
(non-interruption & marked word order)

(9) Ta jiandaole [maidiao qiche de] nawei linju.
He met [sold his car (RC) marker] the neighbor
S V RC O
'He met the neighbor who sold his car.'
(interruption & normal word order)

Sentences (7) and (8) illustrate syntactic normal and marked distinctions while sentences (7) and (9) illustrate interruption and non-interruption distinctions.

There were 15 stimulus sentences which contain 3 tokens (sentences) for each type and 6 distractors. Sentences were controlled for length and only very common lexical items were used so that any difference in ease of processing results from syntactic structures. The distractors were included so that participants would not easily recognize the task as a test of syntactic structures.

2.3 Procedure

The list of 15 stimulus sentences was presented to participants in a sheet of paper. Before the list was presented to subjects the order of items had been randomized in order to minimize order effects. Beside each sentence there are 5 ovals with the value "1" through "9" inclusive.

The scaling system is the following:

9	completely acceptable, sounds natural
7	relatively acceptable, but not as good as (9)
5	uncertain as to acceptability, cannot decide
3	relatively unacceptable, but not completely
1	completely unacceptable, sounds strange

The participants were asked to read the list for the first time and choose the most acceptable sentences and the least acceptable sentences and indicate values "9" and "1" respectively. This should have anchored the scale, which deterred participants from simply assigning value "9" to every or most sentences as all of the sentences in this experiment are grammatical (Prideaux & Baker, 1986). Participants then were required to read each sentence and indicate a value from "1" (completely unacceptable) to "9" (completely acceptable). There were no time constraints and subjects could change their choices if they want at any time of the experiment.

2.4 Results and Discussions

ANOVA has been conducted mainly to test the effects of sentence types in Chinese syntactic processing. Because there are two random variables: subjects and items (sentence tokens which are nested within sentence types) I will use both by-subjects analysis and by-items analysis (Myers & Well, 1991). Through by-subjects analysis F_1 values can be obtained. If F_1 is significant, the effect will be expected to generalize to new subjects. Through by-items analysis, F_2 values can be obtained. If F_2 is significant the effect will be expected to generalize to new items for the selected subjects. Table 1 indicates the mean scores of the 3 sentence types:

Type	Type 1 normal order & non-interruption	Type 2 marked word order & non-interruption	Type 3 normal order & interruption
Mean Score	6.73	6.11	4.47

Table 1 Mean scores of 3 sentence types

Table 2 and Table 3 show the overall main effects and interactions.

By-subjects analysis with items fixed, F_1 is obtained

Source	df	Sums of Squares	Mean Square	F-ratio	Prob
Itm	6	39.1111	6.51852	3.0495	0.0095
Typ	2	123.437	61.7185	11.165	0.0003

Table 2 By-subjects analysis

F_1 tests in Table 2 show that the main effects of sentence types are significant, which means that sentence types have an effect on Chinese processing. F_1 tests also indicate that the main effects of items are significant, which suggests that there is difference between items in processing.

By-items analysis with subjects fixed, F_2 is obtained

Source	df	Sums of Squares	Mean Square	F-ratio	Prob
Sbj	14	182.993	13.0709	6.1149	< 0.0001
Typ	2	123.437	61.7185	9.4682	0.0139
Sbj*typ	28	154.785	5.52804	2.5861	0.0004

Table 3 By-items analysis

F_2 Tests in Table 3 show that the main effect of sentence types is significant, which means that sentence types have an effect on Chinese processing. F_2 tests also indicate that main effects of subjects are significant,

which suggests that there is difference between subjects' acceptability judgment. The Type*Subject interaction is significant.

A two sample T-test was performed on the acceptability scores of sentence type 1 vs. sentence type 2 and sentence type 1 vs. sentence type 3. The results of these tests are displayed in Table 4.

Sentence types	P-value
Sentence type 1 vs. type 3 interruption vs. non-interruption	0.0125
Sentence type 1 vs. type 2 normal word order vs. marked word order	0.2076

Table 4 Results of two-tailed t-tests

The T-test statistic shows that sentence type 1 is different from sentence type 3 in processing. Closure is operative in this study, and thus, it gains cross-linguistic supports. This indicates that sentences with non-interruption are really easier to process than sentences with interruption in Chinese.

The T-test statistic also indicates that there is no significant difference between processing sentences with normal word order (sentence type 1) and those with marked word order (sentence type 2) in Chinese. Thus, Markedness is not supported in Mandarin Chinese syntactic processing in this experiment. It may be due to relatively free word order in Chinese. It seems to be the case that the normal word order (SVO) and the '*ba*' construction (S *ba* OV) can serve different functions in Mandarin Chinese. The marked structure—*ba* construction is similar to topic-comment sentence structure in Chinese (e.g., Li & Thompson, 1981). In a '*ba*' sentence, the object is transposed to the front of the verb, thus putting stress on the verb. Although the basic and unmarked word order is SVO in Chinese, some marked word orders such as SOV are not quite uncommon, and thus, they are not quite unexpected. That is why Markedness is not operative in Chinese language processing.

3. Conclusions

A relative acceptability judgment study was conducted to test the effects of Closure and Markedness in Mandarin Chinese syntactic processing. Closure is operative in this study, therefore, it gains cross-linguistic supports. This indicates that sentences with non-interruption are really easier to process than sentences with interruption in Mandarin Chinese. In this study, Markedness is not supported, which suggests that there is no significant difference between processing sentences with normal word order and processing sentences with marked word order for Mandarin Chinese. This may result from relatively free word order in Chinese. The results of this study indicate that Markedness as a processing strategy may be language-specific, contrary to the belief that it is universal.

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