

Chinese L2 learners' use of structural and lexical information in processing English subject and object relative clauses

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1. Introduction

One of the major tasks in the field of second language acquisition (SLA) is to investigate the nature of second language (L2) learners' grammar, particularly, whether this grammar is also constrained by Universal Grammar (UG) as proposed in first language (L1) acquisition (Chomsky, 1981). To explore this issue, what linguistic competence a L2 learner has becomes a crucial starting point to understand the properties of a L2 grammar. Some researchers argue that L1 acquisition is fundamentally different from L2 acquisition because the latter is involved with problem-solving strategies as well as other learning skills (e.g. Bley-Vroman, 1989). On the other hand, proponents of the view that L2 learners are guided by UG have focused on evidence that L2 learners are able to acquire linguistic properties that are available in neither the L1 nor the L2 input (e.g. White, 2003). Moreover, non-native-like grammars could be the result of performance errors rather than a lack of L2 competence (e.g. White & Juffs, 1998). The latter view seems to be the relevant one to second language sentence processing. The present study intends to bring a parallel view to the issue addressed above by investigating L2 learners' processing strategies. In other words, performance issues, rather than competence issues, will be the focus of our study.

Sentence processing involves a series of complex interactions among different levels of linguistic representation. For instance, when hearing an incoming string of words, the parser must assign structural relationships among words in order to assign the correct meaning to the sentence. The present study is concerned with this aspect of sentence processing. Specifically, previous studies in first language (L1) sentence processing have found that, in English, subject relative clauses (SR) are easier to process than object relative clauses (OR). Processing difficulties in the case of object relative clauses have been attributed to non-linguistic factors such as working memory limitations, and linguistic constraints such as syntactic and semantic properties, etc (e.g. Cook, 1975; King & Just, 1991). In Chinese, the processing of relative clauses is very different from English—OR are found easier to process than SR in L1 Chinese sentence processing (Hsiao, 2003). Hsiao (2003) attributed the differences between SR and OR to syntactic-based models that do not take semantic constraints into consideration. With respect to L2 sentence processing, previous studies have shown that Chinese learners rely more on semantic information

than syntactic information when processing simple affirmative sentences in English (Miao 1981; Su 2001). The present study, building on the findings summarized above, aims to investigate Chinese speakers' L1 & L2 processing strategies on subject and object relative clauses, specifically, the use of syntactic and semantic information during sentence processing. I will further examine whether Chinese learners are able to employ different processing strategies in L2 if they are different from their L1.

The organization of this paper is as follows. Section two describes the relevant theoretical background of first and second language sentence processing. Experimental designs and statistical analyses are discussed in Section three. Finally, Section four provides suggestions and conclusions of the study.

2. Sentence Processing: the State of Art

Traxler et al. (2002) investigated English speakers' processing strategies for subject and object relative clauses by conducting three eye-movement monitoring experiments. In their last experiment, animacy of both NPs in main clause subjects and relative clauses were manipulated. The examples are given in the following.

SR with animate sentential subject and inanimate noun phrase in the relative clause:

- (1) **The director** [that **e** watched **the movie**] received a prize at the film festival.

OR with animate sentential subject and inanimate noun phrase in the relative clause:

- (2) **The director** [that **the movie** pleased **e**] received a prize at the film festival.

SR with inanimate sentential subject and animate noun phrase in the relative clause:

- (3) **The movie** [that **e** pleased **the director**] received a prize at the film festival.

OR with inanimate sentential subject and animate noun phrase in the relative clause:

- (4) **The movie** [that **the director** watched **e**] received a prize at the film festival.

The first part of the results showed that subject relative clauses were easier than object relative clauses when comparing the time spent in the relative clause region. However, the second part of the results indicated that the level of difficulty was greatly reduced in object relative clauses with inanimate main clause subjects and animate noun phrases in relative clauses as shown in (4)

compared to previous experiments. In addition, object relative clauses with animate sentential subjects such as (2) were the most difficult, compared to the other three conditions. Traxler et al. concluded that the Active Filler Strategy (Frazier & Clifton, 1989)—one of the syntactic-based accounts—fits their results best. The Active Filler Strategy (AFS) states that when a filler (a relative pronoun or a complementizer) is encountered, it has to be assigned to the earliest possible gap position. In addition, the parser will treat a main clause subject as a relative clause subject because there is a possible gap following a relative pronoun / a complementizer.

In terms of initial analysis, the AFS successfully predicts the results of Traxler et al.'s experiments in which subject relative clauses were easier to process than object relative clauses. However, with respect to reanalysis, another account is needed to account for the results in experiments two and three in which the level of difficulty was reduced in object relative clauses by the manipulation of animacy and plausibility of main clause subjects and noun phrases in relative clauses. For instance, an object relative clause is easier to process when its noun phrase in the relative clause is animate compared to the one with inanimate noun phrase in the relative clause. Traxler et al. therefore suggest that semantic factors, such as animacy, should also be taken into consideration, especially in reanalysis.

Many studies have investigated L2 learners' processing strategies in various constructions cross-linguistically (e.g. Felser et al, 2003; Papadopoulou & Clahsen, 2003). In what follows we summarize Omake & Ariji's study focusing on syntactic and semantic use in L2 learners' processing strategies upon which the present study is built. Omaki & Ariji (2004) investigated the processing strategies of advanced Japanese learners of English based on Felser et al.'s (2003) claim in that L2 learners rely more on lexical cues than structural information. They replicated Traxler et al.'s (2002) experiments on English native speakers' processing of subject and object relative clauses in which animacy of the first and second noun phrase was manipulated. The test sentences were as follows.

Animate-Inanimate SR:

(5) The musician [that e witnessed the accident] angered the policeman a lot.

Animate-Inanimate OR

(6) The musician [that the accident terrified e] angered the policeman a lot.

Inanimate-Animate SR

(7) The accident [that e terrified the musician] angered the policeman a lot.

Inanimate-Animate OR

(8) The accident [that the musician witnessed e] angered the policeman a lot.

Omaki & Ariji (2004) argued that if the subjects used only structural information, they would find that (5) and (7) (subject relative clauses) were

easier to process than (6) and (8) (object relative clauses). On the other hand, if they only used lexical information, they would process (5) and (8) more easily than (6) and (7) since an animate subject is a better candidate for an agent. However, if the subjects use both lexical and structural information, they would find that (5) and (7) were processed easily, and (6) would be the most difficult one to process. The last prediction is built upon the first two predictions in which SR is easier than OR, and OR with animate subjects such as (8) will be easier to process than the one with inanimate subjects such as (6). The results showed that contrary to Felser et al.'s (2003) claim, the subjects used both structural and lexical information when processing subject and object relative clauses.

Similar to L1 processing research, the L2 studies reviewed above also provide mixed results in relation to the use of syntactic versus semantic information. Our study replicates Traxler et al. (2002) and Omaki et al.'s (2004) studies by investigating Chinese L2 learners processing strategies in English subject and object relative clauses. The goal is not to provide a solution to the argument discussed above; rather, we would like to examine this issue from another different cross-linguistic perspective. In addition to testing Traxler et al. and Omaki et al.'s results, we also examine our subjects' L1 processing strategies in similar constructions. Our aim is to explore the issue of whether Chinese learners will prefer L1 processing strategies when processing their L2, or they are able to adopt language-specific processing strategies in their L2.

3. THE STUDY

The purpose of this study is to investigate Chinese speakers' processing strategies of SR and OR in their L1 and L2, and whether they are able to adopt L2 processing strategies. The specific relative clauses and animate/inanimate sequences that we will be investigating are summarized below:

Chinese relative clauses

SR, Animate-Inanimate

- (9) [e_i Kandao xiaochē de] xueshang_i zuowan henwan dao jia
 Saw school bus DE¹ student last night very late arrive home
 'The student that saw the school bus arrived at home late last night.'

OR, Animate-Inanimate

- (10) [xiaochē jiesong e_i de] xueshang_i zuowan henwan dao jia
 school bus pick up DE student last night very late arrive home
 'The student that the school bus picked up arrived at home late last night.'

SR, Inanimate-Animate

- (11) [e_i yuohuo nuren de] dangao_i keyi zai najia dian maiddao
 tempted woman DE cake can at that store bought
 'The cake that tempted the woman was available in that store.'

¹ DE: Chinese relative clause marker.

OR, Inanimate-Animate

- (12) [nuren xiangyao e_i de] dangao, keyi zai najia dian maidao
 women want DE cake can at that store bought
 'The cake that the woman wanted was available in that store.'

English relative clauses

SR, Animate-Inanimate

- (13) The girl_i [e_i that saw the accident] upset the boy.

OR, Animate-Inanimate

- (14) The girl_i [that the accident terrified e_i] upset the boy.

SR, Inanimate-Animate

- (15) The accident_t [that e_i terrified the girl] upset the boy.

OR, Inanimate-Animate

- (16) The accident_t [that the girl saw e_i] upset the boy.

With regard to Chinese relative clauses, we predict that object relative clauses are easier to process than subject relative clauses and semantic cues are more preferable than syntactic information based on the results of the previous studies (Hsiao, 2003; Su, 2001). We test the following three hypotheses as seen in Omaki et al.'s (2004) study.

Hypothesis 1: use only structural information.

- A. Chinese RC: Chinese subjects will find (10), (12) easier than (9), (11)
- B. English RC: Chinese learners will find (13), (15) easier than (14), (16).
 (Regardless their animacy, OR is easier than SR in Chinese and SR is easier than OR in English).

Hypothesis 2: use only lexical information.

- A. Chinese RC: Chinese subjects will find (9), (12) easier than (10), (11).
- B. English RC: Chinese learners will find (13), (16) easier than (14), (15).
 (Animate nouns are more likely to be agents).

Hypothesis 3: use both structural and lexical information.

- A. Chinese RC: Chinese subjects will find (10), (12) easier to process. (9) will be easier than (11) because (11) has an inanimate agent which is a poor subject.
- B. English RC: Chinese learners will find (13), (15) easier to process. (16) will be easier than (14) because (14) has an inanimate agent which is a poor subject.

3.1 Experimental Design

A sentence complexity rating task was conducted to investigate Chinese learners' use of structural and lexical information in processing English subject and object relative clauses. This method was selected because it reflects participants' intuitions towards the complexity of test items, providing a similar result as in online processing (Warren & Gibson, 2002; Omaki & Arijji, 2004).

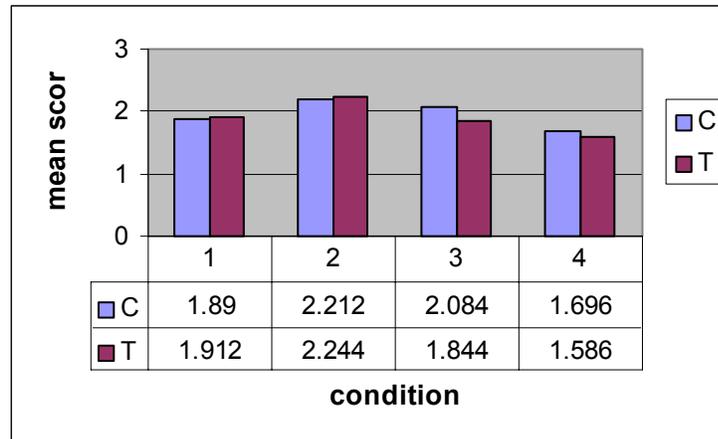
Two groups of Chinese learners of English participated in the experiment. The first group (group C) consisted of 33 subjects who were categorized as advanced learners because they have received a degree or are studying in universities where English is the language of instruction and they are currently living in English-speaking countries. The second group (group T) included 27 subjects who are currently graduate students in Taiwan. The control group (group E) consisted of 15 native speakers of English who reside in Ottawa, Canada and San Jose, U.S.A. The rationale for selecting two groups of Chinese subjects is in the following. Assuming that processing strategies are different in Chinese and English (see the previous discussion), subjects' abilities of adopting L2 processing strategies could be transitional. This phenomenon might be observed in subjects that have different L2 proficiency levels. For instance, the less advanced L2 Chinese learners might still rely on their L1 processing strategies whereas the advanced group might readily adopt specific processing strategies used in L2.

The complexity rating experiment consisted of two parts. The first part adopted Traxler et al.'s (2002) test sentences in English, containing 10 subject and 10 object relative clauses with four combinations of animacy in nouns as seen in the predictions. 20 filler sentences containing other types of relative clauses were included. The second part of the experiment tested similar subject and object relative clauses in Chinese. Test items were taken from Hsiao (2003) and translated from Traxler et al.'s (2002) experiments. There were also 20 test items with four conditions and 20 fillers with other types of relative clauses. Participants were required to give a rating to each test item on a 5-point scale according to its difficulties. The scale is from 1 'very easy', 2 'easy', 3 'average', 4 'difficult' to 5 'very difficult'. The test items were presented on both paper and a computer (depending on whether the subjects are comfortable with using a computer). The task was not timed and there was no break between the two tasks for Chinese subjects.

3.2 Results

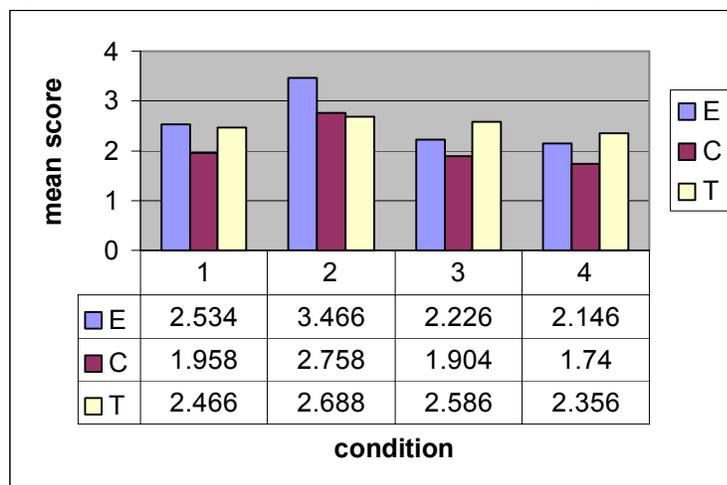
A paired-t test was conducted to determine whether a significant difference existed between subject and object relative clauses for each condition. Means and standard deviations were computed for each condition. The results of Chinese data for groups C (advanced) and T (less advanced) with respect to the mean score of each condition are shown in Figure 1. Condition 2 has the highest mean scores in both groups compared to the other three conditions. The detailed statistical analysis of each hypothesis will be discussed in the following.

Figure 1: The mean score of each condition for Group C & T



Hypothesis #1 states that if subjects use only structural information, they will find Chinese object relative clauses (condition two and four) easier than subject relative clauses (condition one and three). The analysis showed that p-value for both groups was greater than .05, suggesting that there was no evidence of a difference between the two conditions (two & four and one & three). Hypothesis #2 suggests that if subjects use only semantic information, they will find conditions one and four easier than two and three. The results indicated that conditions one and four were rated significantly less complex than conditions two and three in both groups ($p < .05$). Hypothesis #3 states that if subjects use both structural and lexical information, they will find conditions two and four easier than one and three and condition three more difficult than condition one. The results for the first hypothesis were not significant for both groups. Therefore, the third hypothesis that was based on the validity of the first hypothesis was not supported by default. The overall results were consistent with hypothesis #2, suggesting that semantic information plays a more significant role than syntactic cues for both groups when they process Chinese subject and object relative clauses.

The results of English data for groups E, C and T with respect to the mean score of each condition are shown in Figure 2. Condition 2, again, has the highest mean scores in all groups compared to the other three conditions.

Figure 2: The mean score of each condition for Group E, C & T

The first hypothesis (hypothesis #1) states that if subjects use only structural information, they will find both subject relative clauses (conditions one and three) easier than object relative clauses (conditions two and four). The results showed that conditions one and three were rated significantly less complex than condition two and four by groups E and C ($p < .05$). However, there was no evidence of a difference between two conditions (condition two & four and one & three) for group T ($p > .05$). The second hypothesis (hypothesis #2) states that if subjects use only semantic information, they will find conditions one and four easier than two and three. The results indicated that conditions one and four were rated significantly less complex than conditions two and three by all three groups ($p < .05$). The third hypothesis (hypothesis #3) is that if subjects use both structural and lexical information, they will find conditions one and three easier than two and four, which have been discussed in the first hypothesis, and condition two more difficult than condition four. The results showed that condition two was rated significantly more complex than condition four by all three groups ($p < .05$). Overall, the results of the paired-t test were consistent with hypothesis #3 for groups E and C. For group T, the results suggested that hypothesis #2 was supported.

3.3 Discussion

In this paper, we have investigated Chinese speakers' use of syntactic and semantic information in processing Chinese and English subject and object relative clauses. In the Chinese experiment, we found that semantic cues play a more significant role than syntactic cues in Chinese subjects' sentence processing as seen in previous studies despite the different constructions under investigation. The results from our two experimental groups are consistent in relation to their use of semantic information since there are no significant

differences in their responses. In addition, our results in general do not support the claim related to the generalization proposed according to which object relative clauses are easier to process than subject relative clauses, as predicted in Hsiao's study (2002). This is shown in that condition two—OR with the combination of animate and inanimate NPs—is the most difficult compared to the other three conditions. This provides evidence that, in the present study, animacy has a certain influence on processing SR and OR. However, to determine to what extent semantic information plays a role in processing SR and OR will need further research.

With respect to the English experiment, our findings are similar to the ones in Omaki et al.'s (2003) study. That is, the advanced Chinese learners were able to use both syntactic and semantic information, as native speakers of English did in the study. However, there are still significant differences between the rating scores of these two groups (C & E). This does not necessarily suggest that the advanced learners of English have not reached the same level as native speakers of English in terms of processing strategies. It is more likely that processing routines are configured differently for L2 learners, as suggested in Fernandez (1999) or in other studies that argue for the existence of divergence between L1 and L2 in the end state (near-native) of L2 grammar, which refers to competence (Schwartz & Sprouse 1995; White 2003), and in our case, processing grammar.

The implications of this study for second language processing are twofold. First, our findings do not support the claim that advanced L2 learners rely more on semantic cues than syntactic information when processing their L2 (e.g. Papadopoulou & Clahsen, 2003; Felser et al., 2003)². However, the less advanced L2 learners in our study did show a preference for using semantic information. This leads to the second implication of our study in that the less advanced subjects seem to transfer L1 processing strategies to their L2, in contrast to the claim in previous studies that L1 transfer does not occur in processing strategies (Papadopoulou & Clahsen, 2003).

4. Conclusion

Despite the limitations of our study, namely, the small sample size and the use of an off-line task to investigate sentence processing, our study presents clear-cut results in that it shows that advanced Chinese learners of English use both syntactic and semantic information, as native speakers of English do, in processing subject and object relative clauses. Our study also shows that less advanced Chinese learners of English rely on semantic cues, which are the preferred strategies in their L1. We are aware of the fact that off-line tasks might not be as objective as on-line experiments. However, as we have pointed out earlier, our experiments provide insights into what might occur in real time and,

² We are aware that the semantic information used in Papadopoulou & Clahsen (2003) is different than ours. Their work is used as a foundation to infer that semantic information in general might play a role in sentence processing.

from this perspective, our findings can be seen as the foundation for future on-line studies.

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