Processing Passive Sentences in Mandarin Chinese

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Abstract

This study examines the comprehension of Chinese passives to determine the robustness of the canonicity and plausibility effects in Chinese sentence processing. Studies have shown that English passive sentences that express implausible ideas such as, *the dog was bitten by the man* incur higher processing costs compared to plausible sentences (Ferreira, 2003). Whether a similar pattern is found in Chinese passives is the focus of this study.

Keywords

Sentence processing, Psycholinguistics, Passives, Mandarin Chinese,

1 Introduction

People's comprehension of sentences is not always consistent with the input's syntactic form. Instead of interpreting sentences according to the syntactic structure, sentences are often interpreted in a way that is more semantically sensible and consistent with real-world knowledge that might be contrary to the input form. As a result, semantic anomalies are often not detected in syntactically well-formed sentences (Barton et al., 1993).

1.1 Canonicity and plausibility effects in sentence processing

Ferreira's (2003) study shows how syntactically well-formed sentences are misinterpreted. She examined the interpretation of syntactically unambiguous but challenging English sentences such as passives. She found that these unambiguous sentences are often misinterpreted, especially when they express implausible ideas, for example, *the mouse was eaten by the cheese* was often misinterpreted as *the cheese was eaten by the mouse.*

To account for how these sentences are misintepreted, Ferreira followed the NVN strategy proposed by Tonwsend and Bever's (2001) model. Townsend and Bever (2001) proposed that English-speakers adopt the NVN strategy in sentence interpretation, where the subject in a SVO sentence is assigned the agent role (the actor) and the patient role (the actee) is assigned to the object. Noncanonical sentences such as passives are thus challenging because they deviate from the canonical SVO word order, which requires thematic roles to be assigned in an atypical order (Ferreira, 2003). This NVN strategy is effective and the canonicity effect is robust in English because many sentences follow the SVO pattern.

Another factor that accounts for the misinterpretation of noncanonical sentences is the plausibility effect. Semantic plausibility refers to the noun-verb plausibility and an example of non-syntactic information (Thornton et al., 2003). A verb typically has an expected set of agents and patients (Altmann et al., 1999; McRae et al., 2009), and a mismatch between the noun and the verb results in an implausible sentence that is semantically anomalous. People incorporate their real-world knowledge for sentence interpretation (McRae et al.), and implausible sentences are likely to incur processing costs because they express unexpected concepts. The effect of semantic plausibility has been found to be robust in both sentence production and comprehension studies (Thornton et al., 2003; Traxler et al., 2002).

1.2 Processing Chinese passives

The misinterpretation of noncanonical sentences is due to the effects of canonicity and plausibility. Implausible noncanonical sentences are even more challenging because in addition to syntactic complexity, they express ideas that contradict listeners' expectations. Plausibility depends on the logical relatedness of the noun and the verb and canonicity is an effect of a rigid word order of the language. These effects are robust in English, but these effects are unclear in Chinese – which is a language with unique typological features.

Both English and Chinese have SVO as the canonical word order, but the linear position of arguments in Chinese is not as rigid as it is in English. The small number of inflectional markers in Chinese and overall morphological simplicity are balanced by a greater reliance on word order for encoding grammatical and thematic relations (Chao,

1968). This would lead to the assumption that a rigid canonical word order is crucial, but Chinese surprisingly allows many non-SVO variations and subject/object omissions occur frequently.

Chinese is considered a 'topic-prominent' language (e.g., Chao, 1968; Li & Thompson, 1981), which means that the sentence-initial noun phrase in a SVO sentence is not always the logical subject of the verb. The selection of the initial noun phrase in Chinese is not always syntactically constrained, it is pragmatically driven and is related to the its predicate by the vague notion of 'semantic relatedness' (Li & Thompson, 1981). Given this unique property, Chinese serves as a good candidate for assessing the dependence on word order for sentence interpretation. This study focuses on examining the processing of one type of noncanonical sentence in Chinese, namely passives, where the word order is O-*BEI*[1]-S-V. Thematic role assignment follows the patient-agent pattern in a passive sentence instead of the agent-patient pattern in an active sentence. If Chinese speakers use the NVN strategy as English speakers do, passive sentences will incur a processing cost. The comprehension of passives will be examined to determine the effectiveness of the NVN strategy and the plausibility effect. More specifically the following questions will be addressed:

1. In the absence of a rigid SVO word order, how are thematic roles interpreted in Chinese? Is the NVN strategy reliable in Chinese? Does thematic role assignment always follow an agent-patient pattern?
2. What is the effect of noun-verb plausibility on comprehension in a topic-prominent language, where noun-verb combinations are not strictly syntactically constrained?

2 Method

A word-by-word self-paced reading task was used to present the experimental stimuli.

2.1 Participants

Thirty-three native speakers of Chinese were recruited from the Taiwanese community at The University of Texas at Austin. Participants did not receive compensation for their participation.

2.2 Materials and Design

The experiment employed a 2 x 2 within-subjects design, with the independent variables being syntactic form and semantic plausibility. A stimulus sentence is either in the active or the passive and it is either plausible or implausible. A plausible sentence is one in which the agent is an expected and likely argument of the verb, and an implausible sentence is one in which the agent is an unexpected or unlikely argument of the verb. The levels of the two factors are fully crossed, yielding four conditions for every given stimulus set: Active Plausible (AP), Active Implausible (AI), Passive Plausible (PP), and Passive Implausible (PI). A sample stimulus set is shown in (2).

(2) a. daxiang/chidiao-le/chingwa (AP)
elephant/eat-PERF/frog
'The elephant ate the frog.'

b. tsangying/chidiao-le/chingwa (AI)
fly/eat-PERF/frog
'The fly ate the frog.'

c. chingwa/bei/daxiang/chidiao-le (PP)
frog/BEI/elephant/eat-PERF
'The frog was eaten by the elephant.'

d. chingwa/bei/tsangying/chidiao-le (PI)
frog/BEI/fly/eat-PERF
'The frog was eaten by the fly.'

The stimuli sets were distributed in a Latin-square design to counterbalance the stimuli across participants. Four lists were created, and each list contained 24 test items. Each list contained only one version from each stimulus set and all versions from each stimulus set were seen equally across participants. Fifty-six sentences of various syntactic structures were included as filler items, and intermixed with the test items. Participants read a total of 80 sentences from one of the four lists, and the presentation order of the test and filler items was randomized for each participant.

2.3 Procedure

The experiment was set up using PsyScope program and ran on a Macintosh computer. At the beginning of each trial, participants saw an asterisk at the center of the screen against a white backdrop. They pressed the space bar to proceed to the next step where they saw a line of dashes on the screen, with each dash representing a character hence the number of dashes indicated the length of the sentence. The words were displayed non-cumulatively (Just, et al. 1982). Only one word was displayed at once, and pressing the space bar reveals the next word; the previous word reverts back to dash lines. Each item was followed by a comprehension question based on the content of the displayed sentence. All the comprehension

[1] Abbreviations: BEI = passive marker, PERF = perfective marker, 1sg = first person singular

questions were true/false questions. The answers to forty of the comprehension questions were "true" and the other forty were "false." Participants were not given feedback about their answers. Participants were given a practice trial at the beginning of the experiment. Participants were tested individually in a quiet room.

2.4 Data Analysis

Participants' responses was recorded in three forms:
1. Comprehension accuracy: this is to see how accurate the participants were in answering the comprehension questions.
2. Decision time: this is the time between seeing the comprehension question and the time it took for participant to make a decision about the answer.
3. Reading time: as participants are reading the sentences, the time they spend on reading each word of the sentences was recorded.

3 Results and discussion

3.1 Comprehension accuracy

The comprehension accuracy was high across all four conditions, ranging from 98% to 100%.

3.2 Decision time

Decision times more than 3 standard deviations away from the overall mean were excluded from analysis, and this resulted in the removal of 2.4% of the observations (19/792). Analyses of variance were performed with both participants (F_1) and items (F_2) as random effects.

Decision times for active sentences were slightly longer than passive sentences but this difference is not significant, all p's > .70. There is no effect of syntactic form. There is an effect of plausibility; the decision times for implausible sentences were longer than plausible sentences and this difference is significant, $F_1(1, 32) = 14.11$, $p < .001$, $F_2(1, 23) = 7.5$, $p < .02$. Table 1 shows the mean decision times for plausible and implausible sentences.

Table 1. Mean decision times for plausible and implausible sentences

	Mean decision time (ms)
Plausible sentences	1670.05 (SD = 436.27)
Implausible sentences	1884.42 (SD = 431.97)

The effect of plausibility is significant within both active and passive sentences. Within active sentences, the mean decision time for implausible sentences is longer than plausible sentences (1872.34 vs. 1691.19 ms), and this difference is significant by subjects, $F_1(1, 32) = 10.53$, $p = < .003$, but not by items, $F_2(1, 23) = 3.37$, $p > .07$. Within passive sentences, the mean decision time for implausible sentences is longer than plausible sentences (1895.27 vs. 1653.32 ms) and this difference is significant, $F_1(1, 32) = 10.53$, $p < .003$, $F_2(1, 23) = 4.48$, $p < .05$.

There is no interaction between syntactic form and semantic plausibility, all p's > .50. There is no main effect of syntactic form all p's > .50, but there is a main effect of plausibility, $F_1(1, 32) = 13.62$, $p < .001$, $F_2(1, 23) = 7.00$, $p < .02$.

3.3 Reading time

Reading times more than 3 standard deviations away from the overall mean were excluded from analysis, and this resulted in the exclusion of 3.4% of the data (84/2772).

The mean total reading time for active implausible sentences is longer than for active plausible sentences, but this difference is not significant by subjects, $F_1(1, 32) = 1.35$, $p > .20$, but significant by items $F_2(1, 23) = 7.62$, $p < .02$. The mean total reading time for passive implausible sentences is longer than passive plausible sentences, but this difference is not significant, all p's > .20.

Figure 1 shows the reading time spent at each region of the active sentences. There are no significant differences for the time spent for reading subjects and verbs for plausible and implausible sentences, but reading time at the object region is longer for implausible sentences, $F_1(1, 32) = 5.72$, $p < .03$, $F_2(1, 23) = 5.94$, $p < .03$.

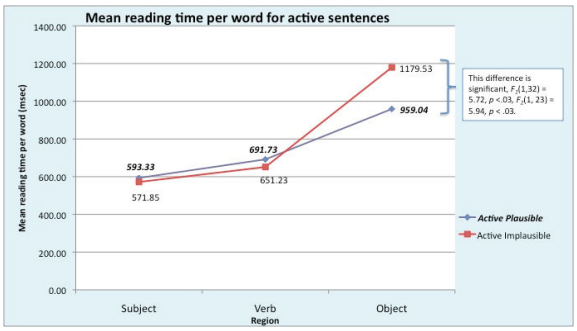

Figure 1. Mean reading time per word for active sentences.

Figure 2 shows the reading time spent at each region of the passive sentences. Surprisingly reading time in the object region is longer for plausible sentences, and this difference is significant by subjects, $F_1(1, 32) = 4.44$, $p < .05$, but not by items, $p > .50$. There are no significant differences in the reading times for the BEI and subject regions between plausible and implausible sentences. There is a trend for reading times at the verb region to be longer for implausible sentences than for plausible sentences, $F_1(1, 32) = 5.72$, $p < .10$, $F_2(1, 23) = 0.73$, $p > 0.4$. This could be

attributed to the relatively larger standard deviation for the verb region for implausible sentence (808.45 ms) than the plausible sentences (534.57 ms). There is an unexpected significant difference at the sentence-initial object position, where the reading time for plausible sentences is longer than implausible sentences. Such difference was not found at sentence-initial position for active sentences. The cause for this reading time difference will need further investigation.

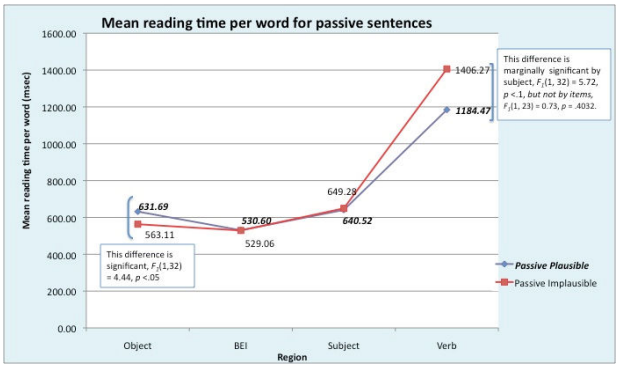

Figure 2. Mean reading time per word for passive sentences.

3.4 Discussion

The results of this study showed an effect of plausibility on the comprehension of Chinese passives. The high comprehension accuracy showed that although passives have a noncanonical word order and greater syntactic complexity, they were rarely misinterpreted. This could be attributed to the overt morphological passive marker *bei* that heightens people's awareness of this noncanonical construction.

Despite the high comprehension accuracy, decision time and reading time data revealed the differences in the processing of sentences that express plausible and implausible ideas. The results from decision time data showed no structural effects on the comprehension of simple active and passive sentences, since decision times were not significantly different between these two sentence types. There were semantic plausibility effects on sentence comprehension, as participants took significantly longer time to make a decision for all the implausible sentences than for all the plausible sentences. Plausibility effect is also evident in the reading time data, where participants spent longer time at sentence-final positions for implausible sentences. Word combinations build up people's expectations about the input sentence (McRae et al., 2009), which explains why implausible sentences incurred a higher processing cost.

4 Conclusion

The results from this study show that despite their structural complexity, passives are not necessarily more difficult to process in Chinese, which suggests a weak canonicity effect. The results also showed that plausibility effect is strong in both active and passive sentences. In Chinese, syntactic information might not be the most relied strategy for sentence processing. If comprehenders were to rely on the NVN strategy, comprehension accuracy on passive sentences would not be as high as those found in the study. Semantic information appears to play a greater role, as shown by the lack of main effect of syntactic forms in decision times. Whether this reliance on semantic information is true and its reliability for other sentence types will require further investigation.

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