The role of animacy in Chinese relative clause processing

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ABSTRACT

Two experiments investigated Chinese relative clause processing by manipulating the animacy of the head noun phrases in the matrix clause (hereafter called head NPs) and in the embedded clause (hereafter called relative-clause-internal NPs) in a self-paced reading paradigm. Experiment 1 showed that subject-modifying object relative clauses (S-ORCs) were easier to process than subject-modifying subject relative clauses (S-SRCs) under animate–inanimate configuration (animate relative-clause-internal NPs and inanimate head NPs), but S-SRCs were easier to process than S-ORCs under inanimate–animate configuration (inanimate relative-clause-internal NPs and animate head NPs). Experiment 2 showed that object-modifying object relative clauses (O-ORCs) were easier to process than object-modifying subject relative clauses (O-SRCs) under both animacy configurations. These results suggest that animacy configuration of the relative-clause-internal NPs and the head NPs plays an important role in Chinese relative clause processing. These results can be explained by thematic fit accounts.

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1. Introduction

Sentence processing involves integration of lexical, syntactic, semantic, pragmatic, and discourse context information (Gibson & Pearlmutter, 1998). In the domain of sentence processing, relative clause constructions, such as (1), have been useful in shedding light on how readers deal with such information.

(1) a. The senator *filler* [who *gap* attacked the lawyer] disliked the editor. (SRC)
    b. The senator *filler* [who the lawyer attacked *gap*] disliked the editor. (ORC)

Based on the function of the head noun (e.g., the senator) within the relative clauses, two types of relative clauses (RCs) are distinguished: the subject relative clause (SRC) and the object relative clause (ORC). In the SRC (1a), the senator serves as the subject in the embedded clause, while in the ORC (1b), the senator serves as the object in the embedded clause.

In past decades, relative clause processing has been thoroughly investigated in different languages with various methods, including self-paced reading (Gibson, Desmet, Grodner, Watson, & Ko, 2005), eye-movement tracking (Traxler, Morris, & Seely, 2002), event-related potentials (ERPs) (Müller, King, & Kutas, 1997), and functional magnetic resonance imaging (fMRI) (Caplan et al., 2002; Chen, West, Waters, & Caplan, 2006). A well-established result is that SRCs are easier to process than ORCs under the condition of double animate NPs in the embedded clause and the matrix clause (e.g., 1). This has

been shown to be the case in English (Caplan, Stanczak, & Waters, 2008; Chen et al., 2006; Staub, 2010), German (Bader & Meng, 1999; Schwartz, 2007), Italian (Domenico & Matteo, 2009), Dutch (Mak, Vonk, & Schriefers, 2002), and French (Cohen & Mehler, 1996).

But the preference for SRCs is not always consistent. Other studies have found that the preference for SRCs is modulated by the animacy of the head and the relative-clause-internal NPs (Mak et al., 2002; Traxler et al., 2002).

There are two key components in a RC construction: the head NP and the restricting RC. The syntactic role and the lexical properties of the head NP play an important role in RC processing. Mak, Vonk, and Schriefers (2006) said: "Since the relative clause is a statement about the antecedent, the antecedent is the topic of the relative clause. Readers tend to choose the entity that is the topic of a sentence or clause as the subject. For the relative clause this means that there is a tendency to choose the antecedent noun phrase as the subject."

Alternative explanations for the effect of the head NP in RC processing are thematic fit accounts (Mak et al., 2002, 2006). According to thematic fit accounts, the semantic fit between the head NP and its corresponding verb may affect RC processing. For example, Trueswell, Tanenhaus, and Garnsey (1994) used animacy to manipulate the thematic fit between the sentence-initial noun phrase and the following verb. This manipulation of thematic fit affected the reading times for the full and reduced RCs. Usually, the by-phrase in reduced RCs, as in (2), shows longer reading times than in the corresponding full RCs. This is because readers prefer treating the past participle (*examined*) as the main verb at first, which has to be revised after reading the following by-phrase. Trueswell et al. (1994) showed that this difference between reduced

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RCs and full RCs disappears when the noun ahead of the verb is improbable as the subject of the verb, as in (3).

(2) The defendant examined by the lawyer …
(3) The evidence examined by the lawyer …

In another self-paced reading and eye-tracking experiment, Mak et al. (2002) also found that the differences between SRCs and ORCs disappeared when the subject of the RC was animate and the object was inanimate. Based on this result, they concluded that semantic factors can override syntactic processing biases.

Still, some studies have argued that the factors that facilitate the establishment of meaningful relationships between parts of a complex sentence do not depend completely on there being semantic relationships between nouns and verbs at the level of events that are likely to occur, as in *fireman rescued* and *robber stole* (King & Just, 1991), in which *fireman* is likely to occur with *rescued* and *robber* is likely to occur with *stole*. Instead, it has been argued that they include relationships at the level of thematic roles (Lowder & Gordon, 2012). For example, in an experiment testing the animacy effect in processing RCs, sentences like (4) were presented, in which ORCs with an inanimate head noun and an animate embedded noun (4b) were as easy to process as SRCs (4c)–(4d), but ORCs with an animate head noun and an inanimate embedded noun (4a) were more difficult than the other three conditions. This difficulty existed not only in the relative clause itself, but also extended to the matrix verb.

(4) a. The cowboy that the pistol injured was known to be unreliable.
b. The pistol that the cowboy concealed was known to be unreliable.
c. The cowboy that concealed the pistol was known to be unreliable.
d. The pistol that injured the cowboy was known to be unreliable.

Thematic roles describe the semantic roles of a noun within a sentence construction. For example, in the sentence *Jane broke the vase*, *Jane* is considered the agent, as she is the initiator of an action, while *vase* is the patient, the entity that is affected by the action (Paczynski & Kuperberg, 2011). According to this account, animate entities tend to appear in the subject position and act as agents, while inanimate entities tend to appear in the object position and act as patients (Dahl, 2008; Malchukov, 2008). When processing ORCs such as (4a), readers have more difficulty treating the sentential subject as the object of the RC or a thematic patient, when the sentential subject is a sound agent.

Additionally, Mak et al. (2006) argued that the animacy effect in RC processing was modulated not only by the thematic fit between the head NPs and the corresponding verbs, but also by the topic-worthiness of the head NPs. According to the topichood hypothesis, the choice of the subject of the RC is determined by the topic-worthiness of the entities. Other things being equal, the head noun of the RC is more topic-worthy than the relative-clause-internal noun, because it is the topic of the relative clause. What's more, the topic-worthiness of the entities is also determined by animacy. Generally, animate entities are more topic-worthy than inanimate entities. So people are apt to place animate entities in the subject position. This means that readers tend to treat sentences with animate NPs in the subject position as SRCs, and treat inanimate NPs in the subject position as ORCs. In other words, the animacy effect in processing RCs is due not only to the semantic or thematic fit between the head NPs and their corresponding verbs, but also to the animacy of the head NPs.

Chinese also has relative clause structures. However, unlike RCs in English, Chinese RCs such as (5) and (6) are head-final sentences with the embedded clause ahead of the head nouns. This means that the animacy of the head nouns can't guide the parsing of the embedded clause, as in English, since the head nouns come after the embedded

clause. What's more, Chinese RCs have no definite relational markers, such as "that" and "who" in English. In Chinese, 的 (de) serves as the relative clause marker (hereafter called *relativizer*), but its function is not the same as "that" and "who." Besides being a relative marker, the word 的 (de) is also used as an adjective marker (e.g., 蓝色的天空, "the blue sky") or a possessive marker (e.g., 我的书包, "my book"), which might add difficulties in processing Chinese RCs. Such cross-linguistic differences in syntactic structure lead us to find out whether the animacy of the head nouns (the "antecedent") influences Chinese RC processing.

(5) a. Subject-modifying SRC (S-SRC):

[$_{gap}$ 攻击 议员 的] 律师 $_{filler}$ 不 喜欢 那位 政客。
attacked senator de lawyer doesn't like the politician
The lawyer $_{filler}$ that $_{gap}$ attacked the senator doesn't like the politician.

b. Subject-modifying ORC (S-ORC):

[议员 攻击 $_{gap}$ 的] 律师 $_{filler}$ 不 喜欢 那位 政客。
senator attacked de lawyer doesn't like the politician
The lawyer $_{filler}$ that the senator attacked $_{gap}$ doesn't like the politician.

(6) a. Object-modifying SRC (O-SRC):

那位 政客 不 喜欢 [$_{gap}$攻击 议员 的] 律师 $_{filler}$
the politician doesn't like attacked senator de lawyer
The politician doesn't like the lawyer $_{filler}$ that $_{gap}$ attacked the senator.

b. Object-modifying ORC (O-ORC):

那位 政客 不 喜欢 [议员 攻击$_{gap}$ 的] 律师 $_{filler}$
the politician doesn't like senator attacked de lawyer
The politician doesn't like the lawyer $_{filler}$ that the senator attacked $_{gap}$.

Most previous studies on Chinese RC processing focused on subject-modifying RCs with double animate NPs, such as (5). However, studies on subject-modifying and object-modifying RCs with different animacy configurations in the embedded clause and in the matrix clause were scarce, which was a limitation in generalizing findings on Chinese RC processing. Studies based on corpus analysis have found that, in Chinese, RCs with different animacy configurations occur more frequently than RCs with double animate NPs (Pu, 2007; Wu, 2009). Additionally, Chinese is a topic-driven language, which means that the topic is apt to be focused on sentence processing, and readers tend to construct representation according to the relationship between the topic and its corresponding verb regardless of the word order. Accordingly, thematic information may play a more important role than word order does in Chinese RC processing.

Therefore, the present study aimed at exploring the following questions regarding Chinese RCs processing:

i) How does the animacy configuration of the relative-clause-internal NPs and the head NPs affect Chinese RC processing?
ii) Does the effect of animacy vary with the position of the embedded clause?

To answer these questions, two experiments were conducted. Experiment 1 explored the processing of subject-modifying RCs with different animacy configurations. Experiment 2 focused on object-modifying RC processing. Thematic fit accounts would predict that the difficulty in processing Chinese RCs will vary with the animacy configuration of the head NPs and the relative-clause-internal NPs. Specifically, RCs with the animate head NPs in the subject position and inanimate NPs in the object position should be easier to process.