



THE POSITION EFFECT ON PROCESSING NOMINAL CLAUSES: EVIDENCE ON A TRANSLATION TASK

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Abstract

There have been accounts on why processing object relative clauses is more difficult than processing subject relative clauses. One account attributes the difficulty to the increase of working memory load, another to the roles of sentential subject plays, still another to the differences in perspective consistency. The present study is intent on probing the effect of different serial orders (position factor) in processing two different types of nominal clauses to check whether serial model for processing sentences also fit with other accounts mentioned above. The primary assumption of this study is that there is more processing difficulty in nominal clause as subject than as object based on the number of operational cognitive steps involved. The research question is: Are Subject nominal clauses more difficult than Object ones in the course of processing? A total of 30 participants were recruited to do the translation work on English sentences with either Subject or Object nominal clauses, the performance of which will be measured by the time spent (seconds). The results indicate that time spent on Subject nominal clauses are significantly longer than Object ones. Thus the assumption that the number of operational steps involved can be a criterion to measure difficulty level of sentence parsing.

Keywords: cognitive steps, subject nominal clause, object nominal clauses, sentence processing

Introduction

This study mainly concerns about the different levels of operational cognitive steps involved when processing nominal clauses as subject and object in the main clause. According to the findings on processing subject and object relative clauses, sentences containing object-relative clauses were more difficult to process than sentences containing subject-relative clauses during the relative clause and the matrix verb. Second, the reader experienced greater difficulty during processing of sentences

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containing object-relative clauses than subject-relative clauses. Last, the difficulty associated with object-relative clauses was greatly reduced when the sentential subject was inanimate. This difference in difficulty has been attributed variously to working memory limitations, syntactic factors and perspective-shifting (Hopp, 2014; Pan, Schimke & Felser, 2015; Matthew, Traxler, etc. 2002). There are results which provide evidence against a garden path model of sentence processing which initially computes only a single analysis, which states that there are also possible mechanisms underlying the identification of contrast sets (Jacob & Felser, 2016; Novick, Hussey, Teubner-Rhodes, etc. 2014; Pozzan & Trueswell, 2016; Sedivy, 2002). By the same analogy, the intention of the current study is to explore the effect of different serial order in processing two different types of nominal clauses to see whether the three accounts also hold valid when processing nominal clauses. Based on the findings from the investigations mentioned above,

Literature Review

Previous studies concerning sentence processing mainly centered on the accounts of processing difficulties involving sentences permissible under the grammatical constraints of a language (Witzel, Witzel, & Nicol, 2012; Pan, Schimke, & Felser, 2015; Miller, 2015) Furthermore, a great deal of the study in this field has focused on difficulties resulting from sentences of ambiguity among various grammatically possible analyses in the course of parsing (Novick, Hussey, Teubner-Rhodes, Harbison, & Bunting, 2014; Pan, Schimke & Felser 2015). Such a sentence like (1a) is found to be more difficult than a sentence such as (1b), despite the ambiguous fragment “*The horse raced past the barn...in both*” (Sedivy, 2002). In (1a) the ‘*raced*’ is a past participle, whereas in (1b) a past tense verb coordinates with ‘*fell*.’

(1a) The horse raced past the barn fell.

(1b) The horse raced past the barn and fell.

Cases of processing difficulties, as in (1a), could be explained by the interplay of semantic and syntactic distinctions (Crain and Steedman, 1985). The most recent study of relative clauses regarding processing difficulty in comprehension and production by learners of English as a Second Language (Izumi 2003), tested the predictions of three major hypotheses of relative clause acquisition in second language acquisition, these hypotheses are based on different rationales and make different predictions on the difficulty order of different relative clause sentence types. The result shows in general that L2 intermediate proficiency learners are presumably adopting a word order-based processing strategy in using English that taxes the learners’ developing processing capacity heavily. Furthermore, processing difficulty of learners with L2 sentences may be best understood in relation to the particular task in which they engage. This means that the development of the learners’L2 knowledge should be captured not in the

abstract, but in the dynamic use of it in different tasks, especially, in its use in both production and comprehension. Furthermore, one recent study that dealt with Subject and Object Relative Clauses processing found that readers experienced greater difficulty during processing of sentences involving object-relative clauses, as in (2a), than subject-clauses, as in (2b) (Traxler, Morris, and Seely, 2002.)

(2a) The lawyer that irritated the banker filed a lawsuit.

(2b) The lawyer that the banker irritated filed a lawsuit.

In sentence (2a), the extracted element is *lawyer*, serves as the syntactic subject of the main clause (as in, *the lawyer filed a lawsuit*) and the relative clause (as in, *the lawyer irritated the banker*). By contrast, the extracted element in (2b) serves as the syntactic subject of the main clause, but as the direct-object of the verb in the relative clause (as in, *the baker irritated the lawyer*), and hence the noun-phrase in the relative clause serves as the syntactic subject of the relative clause. Sentences like (2a) and (2b) can also be viewed as representing a semantic domain specified by the head (e.g., lawyers) that is restricted by the content of the relative clause (e.g., of all possible lawyers represent the one that caused a banker to be irritated or the one that a banker caused to be irritated (Keenan & Comrie, 1977).

One of the accounts, memory-based account, attributes the greater difficulties in object-relative clauses to increased working memory load in processing (e.g. Ford, 1983; Frazier & Fodor, 1978.) In (2b), the phrase *the lawyer* was detached longer by the chunk that *the banker irritated* than that in (2a) by the single word *that*. It seems that the longer the detached subject from its verb, the more memory load is required, thus causing more difficulties. However, the findings are also compatible with an account that attributes the disruption of processing to switching attention back and forth between the comprehension task and the recall task (Caplan & Waters, 1999). Gibson (1998) argued that the detached subject (*the lawyer*), intervened by referring expressions (*that the banker irritated*), from the main verb (*filed*) might cause difficulties in the process of integration. Such difficulty can be reduced by indexical pronouns such as *he, I, me*, for these pronouns help integrate the referents and the themes of the whole sentence.

Another account, syntax-based account, attributes the greater difficulties for object-relative clauses to differences in the roles the sentential subject plays in subject- and object-relative clauses (Sheldon's (1974) parallel function account). In (2a), the sentential subject *the lawyer* is also the syntactic subject of relative clause. That is *the lawyer* is, in the reader's representation of the sentence, a consistent thematic agent of both verbs. Yet in (2b), the sentential subject *the lawyer* is the direct object of the verb in the relative clause. Hence, the reader must treat *the lawyer* as a syntactic subject and a syntactic object, and as thematic agent and a thematic patient at the same time. In this regard, more difficulties will be found in processing (2b).

Another much similar account to syntax-based account is perspective-shifting account, which attributes the greater difficulties for object-relative clauses to differences

in perspective consistency (MacWhinney & Pleh, 1988). In the subject-relative constructions of (2a), the perspective consistency is maintained (only one constituent serving as subject throughout the sentence). Yet in the object-relative constructions of (2b), a perspective-shifting is required (one constituent serving as subject, while the other as object), which will create more difficulties since readers must shift their perspective when encountering the relative-clause subject and once again when they return to processing the main clause.

These three accounts for processing adjectival clauses mainly focus either on syntactical factor (as in memory-based), or on semantic factor (as in perspective - shifting account and syntactic-based accounts). In one study by Traxler, Morris, and Seely (2002), there was a consensus in predicting the relatively more difficulties involved in object-relative clauses by the above-mentioned accounts, but some predictions made by these accounts were not supported. Further, none of these accounts are satisfactory in explaining the complexity involved in sentence parsing. First, the language data used in research are different, with some exclusively on relative clauses, others adverbial clauses (as in Millis and Just, 1994). Second, factors involved in the processing of sentence are not readily specified as syntactic, or semantic, or interaction of both (as in MacDonald, Pearlmutter, & Seidenberg, 1994; Trueswell, Tanenhaus, & Kello, 1993). Third, there are few studies that specifically compare the differences of nominal clausal structures to test the serial effect in sentence processing, and specify the difficulties in terms of operational cognitive steps. See the sentences below:

- (3a) That the banker irritated the lawyer is known.
- (3b) We know that the banker irritated the lawyer.

In (3a), the chunk *That the banker irritated the lawyer* is the Subject, but it is Object in (3b) Apparently, the word orders in these two sentences are different. This can be specified by their relative positions (serial), and the cognitive processes involved in them might also be different. To understand how these two clauses are processed on syntactical aspect and how they are interpreted through operational cognitive steps is significant may help us gain a global picture of how we process sentences. Thus, the present study is intent on probing the effect of different serial orders (position factor) in processing two different types of nominal clauses to check whether serial model for processing sentences fit with other accounts mentioned in this article.

As suggested by (3a), and (3b), nominal clauses can be specified by their relative locations in a sentence. For convenience, see the Pattern below:

N	V	N
(1)		(2)

Note that (1) and (2) stand for nominal clause on N (subject), and (Object/complement) respectively. The N V N is the main structure, and nominal clauses (N) are normally in position (1) and (2). From the pattern above, sentence (3a) is in position (1), while sentence (3b) in position (2).

- (3a) That the lawyer irritated the banker is known.
(3b) We know that the lawyer irritated the banker.

It is legitimately to assume that such a position difference may reflect different cognitive processes, which can be specified below (note that the number of steps is counted by the number of 'complete structure unit;' that is, the count of structure in the form of N V N is 1, thus implying 1 cognitive step (Guey, 2000):

- (3a) We know that the lawyer irritated the banker..
→ (We know X) + (X= *that the lawyer irritated the banker.*)
→ 2 steps
- (3b) That the lawyer irritated the banker is known.
→ (X= *That the lawyer irritated the banker*) + (*is known*) + (X *is known*)
→ 3 steps

Nominal clause in position (1), though treated as a subject of the main verb, may cause more difficulties in processing than that in position (2), because the former may require additional cognitive steps.

Based on memory-based account, the difficulties for processing object relative emerge from the distance between sentence subject and the clause verb. For example, the sentence subject (the lawyer) and the clause verb (irritated) are detached by only one word (that) in (2a), but three words (that the banker) in (2b). Thus it is more difficult to process (2b). If this is the case, some predictions can be made in terms of our Serial (position) model in Figure 1. In (3b) (That the lawyer irritated the banker is known) where the sentence subject is a long string of words (That the lawyer irritated the banker), thus causing more processing difficulties. In (3a), on the other hand, there is no detachment between 'We' and "know", nor is there between 'the lawyer' and 'irritated.'

As to the Syntactic-based or perspective shift accounts, difficulties of processing sentences will be affected by the consistency between thematic agents (subjects) of two verbs. If they play the same role, the processing difficulties can be reduced. For example, the subjects of 'irritated' and 'filed' are 'the lawyer' in (2a), but not in (2b), so processing the former may cause relatively less difficulty. But in the case of (3a) and (3b), Subjects of both verbs are different, so no differences can be expected between them. In the present study, the serial position effect, in relation to the main verb will be tested on the basis of the cognitive-step counts involved in processing. The research

question is: Is there any significant processing difference between nominal clause as Subject and that as Object? The assumption is: There is more processing difficulty nominal clause as Subject than as Object.

Method

The Independent variable is: Clauses (Subject, Object nominal clauses), while dependent variables are Time spent on translation. A total of 30 subjects have to go through all of the 8 items of both Subject and Object Noun Clauses. Subjects are to be asked to translate all the items one by one, and a stopwatch will be used to measure 'Time' spent on each item of each subject. In order to further probe the processing time, the Time spent on each item is further differentiated into Thinking time and Writing Time due to the fact that most students will constantly refer back to the item when writing down the corresponding translation. Therefore, there are two Time measures on Subject and Object Nominal Clauses.

The null hypothesis is: There will be no significant difference of Test scores (the number of the correct item) and Time spent between Subject and Object Nominal Clauses. The alternative hypothesis is: There will be a significant difference of Test scores (the number of the correct items) between Subject and Object Nominal Clauses with the former fewer than the latter. (One-tail test)

The participants consist of 14 males and 16 females, aged 21 EFL learners of junior university students with English major, who have roughly 8~9 years of regular courses of English learning for academic purpose as well as 3 credits of English Translation course.

All the participants are required to translate each of the 8 randomized sentences with 4 nominal clauses as subjects and the other four nominal clauses as objects. To make them familiar with the task, one sentence for each category is used as practice before the experiment. Subjects are measured with time spent on each item on individual bases. Data for subjects' two measures (Thinking time and Writing time) are collected and analyzed separately through t-test.

Results and Discussions

As indicated from t-test results, the average Thinking time spent on Subject Nominal Clauses (N=30, M= 16.3 seconds for odd number items) is much longer than that on Object Nominal Clauses (N=30, M= 13.6 seconds for even number items). A t-test indicates that the Thinking time difference between these two clauses is significant. ($t = 4.66 > 3.65$, $p=0.001$.) Similar result can also be found in Writing time spent on Subject Nominal Clauses (N=30, M= 88.1 seconds for odd number items) is much longer than that on Object Nominal Clauses (N=30, M= 74.4 seconds for even number items). A t-test also indicates that the Writing time difference between these two clauses is significant. ($t = 4.13 > 3.65$, $p=0.001$.)

Such significant difference clearly shows that processing Subject nominal clauses takes more cognitive steps than processing Object nominal clauses, thus taking more time. The results therefore strongly support our assumption that position difference may reflect different cognitive processes, with Subject nominal clauses involving more steps than Object nominal clauses.

Table 1: t-test of time spent on processing Subject and Object nominal clauses

Time spent	Position	Total	N	M	S	S ²	df	t	P
Thinking (seconds)	Subject	489.2	30	16.3	83	537.6	29	4.66	<.001
	Object	406.9	30	13.6	2.8	17.9	29		
Translation (seconds)	Subject	2641.6	30	88.1	410.1	15121.9	29	4.13	<.001
	Object	2231.9	30	74.4	13.7	504.1	29		

However, there are problems yet to be solved. First, if the account of cognitive steps works, how do we objectively define and calculate the exact number of cognitive steps? From the result of the study, the extra time spent on Subject nominal clauses is on average one-fifth (16.3-13.6 / 13.6=0.2), as compared with that on Nominal clauses. Can we legitimate to say that the extra cognitive step for Subject nominal clauses will cost roughly 1/5 of the total processing time? This question cannot be answered without further research specifically designed to clarify the exact steps involved. Second, the present study focused on position difference in Nominal Clauses, but without the comparisons of other clauses such as Adjectival and Adverbial clauses, the results of the present study along with its assumption cannot be verified. In this regard, further study should be comprehensive enough to test the position effect, so the present study is at most only a pilot study, and further studies are necessary.

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