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# An Investigation of Sentence Comprehension with Regard to Processing Mechanism of English Relative Clauses by EFL Learners

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**ABSTRACT**

Sentence comprehension in EFL contexts is influenced by many factors. One of the most important ones is the processing mechanism of relative clauses which can be analyzed in different frameworks by researchers. So far, a wide range of research has been conducted on the processing mechanism of relative clauses in a number of languages. The results have shown a tendency toward two major categories which have been proven to be of significance, namely, subject preference and object preference. Studies conducted on native speakers of English, for instance, have demonstrated subject preference by the participants. In this study, the researchers conducted a self-paced reading experiment employing Linger software, and the data were analyzed using the SPSS software. The study has investigated the processing mechanism of English relative clauses by Iranian EFL learners. The participants were 27 male and 63 female advanced English learners majoring in English literature, all being native speakers of Farsi. The results indicate that Iranian EFL learners also show a tendency towards subject preference in processing relative clauses. Finally, the researchers have discussed the reasons behind such a tendency among the participants of the experiment in terms of a number of theories and principles. The findings of this study are expected to be employed in language syllabus designing as well as in grading or sequencing of materials by educators and materials developers.

**Key words:** Relative Clauses, Processing Mechanisms, Comprehension Latency, Self-Paced Reading, EFL Contexts

## INTRODUCTION

As relative clauses may potentially contain various grammatical and lexical elements, the process of such structures indeed calls for a rather high level of cognitive ability, placing a greater burden on the working memory at the same time. Relative-clause structures are quite common across most languages. The structures of relative clauses is, however, divergent across languages. For instance, Aoun and Li (2003) point out various types of relative clauses in different languages such as English, Mandarin, Japanese, as well as Arabic, and then suggest that, as a matter of fact, non-uniform formal structures and derivations for relative clauses in different languages do exist (e.g., head raising vs. operator movement, adjunction vs. complementation, and so forth). Three typological aspects regarding the structure of relative clauses are of main concern when it comes to research. In general, research on the structure of relative clauses can be about head position (e.g., head-initial vs. head-final), basic word orders (e.g., SVO vs. SOV), and relativizers. This research, however, lies within the realm of the second type, that is, basic word orders in terms of comprehension and processing of relative clauses.

Sentence comprehension research has been of great concern for linguists, psychologists and educators for a long time; however, the processing mechanism of relative clauses has rather scarcely been the focus of studies by scholars in the field of language learning and teaching. An important factor in comprehension and processing of relative clauses is the perception of sentences, with regard to their pronouns and references, whether they are in subject relatives or object. Biber, Johnson, Leech, Conard, and Finegan (1999) define relative clauses as a subordinate clause which modifies a noun or noun phrase (NP) in an associated main clause. They conclude that two features typically characterize the structure of a relative clause:

(1) The syntactic role of the main-clause element functioning as the head of the relative clause (i.e., the element that is modified by a relative clause).

**For example:** *The father ran to* ***the child*** *that played with the babysitter and hugged him.*

The syntactic role of the main clause element 'the child' in the above example is OBJECT.

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(2) The syntactic role of the element that is gapped or relativized inside of the relative clause (also called the focus of the relative clause).

**For example:** *The father ran to the child that played with the babysitter and hugged him.*

The syntactic role of the gapped element inside the relative clause above (**the child** played with the babysitter) is the subject of the clause. Drawing on the features outlined above, scholars have specified different kinds of relative clauses. Biber et al. (ibid.) have also gone further, proposing a categorization as follows:

(1) SS relatives, in which the main-clause subject is modified by a relative clause in which the subject is relativized;
**Example (1):** The guy that argued with his brother talked to his friend and killed him.

(2) SO relatives, in which the main-clause subject is modified by a relative clause in which the object is relativized;
**Example (2):** The guy that his brother argued with talked to his friend and killed him.

(3) OS relatives, in which the main-clause object is modified by a relative clause in which the subject is relativized;
**Example (3):** The friend talked to the guy that argued with his brother and killed him.

(4) OO relatives, in which the main-clause object is modified by a relative clause in which the object is relativized.
**Example (4):** The friend talked to the guy that his brother argued with and killed him.

Since a long time ago, linguists as well as psycholinguists have always looked for a universal which can be applied to different contexts regarding the language processing preference in subject and object relative clauses. Based on what has been found in the previous studies, processing of English subject relative clauses, as a matter of fact, is far easier compared to object ones (Traxler et al., 2002; Gibson, 1998). The subject-preference perception just mentioned is backed by other Indo-European languages such as German (Schriefers et al., 1995), French (Cohen & Mehler, 1996) and Dutch (Mak et al., 2002). Nevertheless, the concept of subject preference has received, to the best knowledge of the researchers, no challenge whatsoever in Iran.

This study is conducted to investigate and draw an analogy between perception of relative clauses and the way they are used and situated in an English sentence by Iranian advanced learners of English. The major focus of the study, thus, is basically sentence processing as far as relative clauses are concerned.

## Theoretical grounding

The study is based on the two factors in the structure of a given relative clause, namely, *embeddedness* and *focus,* which can be of importance in the processing as well as producing a relative clause by EFL learners and even native speakers (King & Just, 1991). Embeddedness, chiefly, addresses the position of a given relative clause compared to the sentence. It can be categorized into center-embedding and right-branching. Center-embedding refers to the kind of relative clause that is situated at the subject position of a given sentence, while the subject of the matrix clause functions as the head noun.

**Example: A school boy** that ~~**he**~~ enjoyed spending time with a classmate ran to his mom and hugged him.

On the other hand, right-branching refers to relative clauses that are known to be of object position, that is, their head noun is actually the object of the given sentence.

**Example:** The mom ran to **a school boy** that a classmate enjoyed spending time with ~~**him**~~ and hugged him

An overview of the research done shows that center-embedding relatives are easier to process when they are compared to right-branching ones. Provided that the focus (head noun) functions the subject of the relative clause, the clause is technically called a subject-extraction relative clause that is abbreviated as SRC. Likewise, a relative clause with a head noun serving the function of its object is named an object-extraction relative clause (ORC). The following example clarifies the point:

1. The guy that argued with his brother talked to his friend and killed him.
2. The guy that his brother argued with talked to his friend and killed him.
3. The friend talked to the guy that argued with his brother and killed him.
4. The friend talked to the guy that his brother argued with and killed him.

Looking at the examples, from 1 to 4, we can see the fact that they are, respectively, center-embedding SRC, center-embedding ORC, right-branching SRC and right-branching ORC. Accordingly, these kinds of differences in the structure of relative clauses can result in a number of problems in the processing preference employed by the reader or listener. One other basic element being investigated in this study is the canonical word order and its variation in the surface structures of different sentences. Basically, variation of word-orders across different languages influences the access of the relativized gaps depending on which structural position a gap is located in the sentence. A central question in the study of language is the distinction made between the underlying word order (e.g. Subject-Verb-Object), also called canonical order, of a given language and various surface structures of these elements. Generally, it is accepted that some languages have dissimilar canonical orders. Some languages are strongly ordered in terms of canonical word order, and others are not.

## Review of related literature

**Background of the study:** According to Sheldon (1974), who worked on a corpus of journal articles, relative clauses are of various natures in different genres, which leads to different effects on readers. Chang, (2008) reported the use of full and reduced relative clauses and their emphasis shifts. Gibson (1998) made a comparison between different types of relative clauses used in a specific kind of genre which demonstrated the relationship between the use of relative clauses and the stylistic techniques employed by the authors.

Furthermore, frequencies of different types of relative clauses have been studied in a number of research articles in which it was claimed that subject relative clauses are used more than object relative clauses. Relative clauses have been extensively scrutinized from various angles. The investigation of relative clauses based on corpus studies has proved to be a very much fruitful area of research. Chang (2004) categorizes the research on relative clauses into three main groups. Accordingly, the first type of research investigates the universals of language in dealing with information within relative clauses; the second looks into the instructional impacts on relative clause acquisition ,and the third one examines "the cross-linguistic influences" on language learners' acquisition of relative clauses. Knowing that they can be an important source of error in different aspects of language use; it is worth mentioning that studies on mistakes made by EFL students are still lacking. Furthermore, little attention has been given to this in the context of Iranian EFL students. The present paper discusses common errors taking place in academic writings of Iranian students. The main objective of this paper is to identify the recurrent patterns and thus the sources of these mistakes. Biber et al. (1999) accounted for a categorization of relative clauses as follows:

Table 1. Categorization of Relative Clauses

| | |
|---|---|
| Restrictive | -ing clauses<br>-ed clauses<br>-prepositional clauses |
| Non-restrective | -ing clauses<br>-ed clauses<br>-prepositional clauses |

### Studies of relative clause conducted in language learning contexts concerning subject or object preference

According to what was said in the review above, it is seen that subject preference is actually accepted in English language and supported by a large number of research works and theories, while this matter has not been investigated yet about learners as much. Most studies have worked on the native speakers; however, a few researches on the acquisition of relative clauses by second language learners have been condocted as well. For instance, Grass (1980), Doughty (1991) and Hamilton (1994) have, in separate studies, demosntrated that the acquisition of subject relative clauses in English as a second language, subject relatives are more easily produced and comprehended than object relatives. Likewise, Sakamoto and Kubota (2000) also demonstrated the prominance of subject preference in the acquisition process of Japanese relative clauses by English participants. In the year 2007, Kanno conducted another research on the factors influencing the processing of Japanese relative clauses used by second languale learners. On the other hand, the matter of subject preference is not actually applicable when it comes to all L2 learners. Accordingly, Virginia Yip and Stephen Matthews carried out a research in 2007, which was about Relative Clauses in Cantonese-English Bilingual Children concluding that object relatives were ,in fact, produced before subject ones. As one can see, this is being a challenge to the language universals. That is, in spite of all the research done on this subject, there actually is a scarecity of research, to the best knowledge of the researcher, about the processing mechanism of English relative clauses used by Iranian English learners. Therefore, in the present study, the researcher has used some Iranian upper-intermediate and advanced English learners with the aim of knowing whether English subject preference is also applicable to the Iranian English learners or not, and also investigate possible causes.

## METHODOLOGY

### *Participants*

Ninety EFL students (of 63 females and 27 males) studying English literature at Ferdowsi University of Mashhad, Iran, were randomly chosen to participate in the experiment. They were senior English literature students aged from 19 to 24, all being Persian native speakers. Gender was not accounted for as a variable in the study.

### Materials

As it will be illustrated, the present study has used a 2×2 factorial design. Accordingly, 24 sets of sentences were constructed, each of which had been formed in four different conditions, as mentioned in the theoretical background of the study, that is the subject-modifying subject relatives (S-SR), the subject-modifying object relatives (S-OR), the object-modifying subject relatives (O-SR) and the object-modifying object relatives (O-OR). To eliminate any possible confussion caused by other interfering factors, all of the noun phrases used the target sentences were chosen to be animate. Here is one example:

1. The guy that argued with his brother talked to his friend and killed him.
2. The guy that his brother argued with talked to his friend and killed him.
3. The friend talked to the guy that argued with his brother and killed him.
4. The friend talked to the guy that his brother argued with and killed him.

Along with the 24 sets of target stimulus, 40 fillers of various types were added into the experiment so as for the participants not to be able to find out what we were trying to test and form a thinking pattern based on which they answer the questions. Furthermore, naturally, all these sentences were written and displayed in standard English. A complete list of the used 24 sets of sentences is found in the appendix of the current paper.

### Procedures

**Peocedure of data collecton:** The researcher employed an experiment we employed in this study was a self-paced reading experiment, using a moving window display. To do so, we ran the experiment using Doug Rohde's Linger software, which is a widely used software in self-paced. All the experiment was held on researcher's laptop. Before beginning the experiment, the participants were told to read some instructions. As well as this, a number of practice sentences and questions were shown to inform them about the format of the presented questions. After asuring that no problem is left, our participants were left undisturbed to do the experiment themselves. In each trial, participants were presented with a series of hyphens showing the length and position of words in the given sentences. The participants were to press the spacebar to view each word. Each time the spacebar was pressed, a new word showed up on the screen and the previous one disappeared, this is done to the point that the whole given sentence was read by the the participants. The time between these two presses was measured by the software as the reading time of the word. After the completion of each sentence, a relevant yes or no comprehension question concerning the preceding sentence showed up. Afterwards, the participants were asked to press F key on the commputer keyboard for —yes or J key for —no. As an incorrect answer was recognized, participants were shown with —Oops, wrong answer on the screen. However, no response was shown providing the answer was correct. The participants were to read the sentences at a natural speed and make sure that they were cautious enough to comprehend the meaning of the sentence. After the completion of the tasks, the researcher gathered the response-time data and saved them for later SPSS analysis.

**Procedure of data analysis:** Having gathered the required data using a self-paced reading instrument, we acquired two important pieces of information, namely the accuracy of responses and the response times of each participant. The data were, subsequently, put into analysis using SPSS software. As for the accuracy, simply the accurate answers were put against the inaccurate –wrong- answers for each item, and the frequency of each was concluded with a percentage showing its relevant difficulty for the participants, who were advanced learners of English. Afterwards, as a purpose of the study, response time of each sentence presented in the experiment –latency-which is a significant factor in the experiment, was calculated in six positions in the sentences, it was then tabulated. Using SPSS program, the mean and standard deviation of each position was calculated for further analysis. Having measured and listed the response time of each position, the researchers drew a comparison between subject relatives and object relatives employing Oneway ANOVA.

## RESULTS AND DISCUSSION

### Accuracy

Employing the SPSS software, all the question response accuracies for each condition are collected. That is, as seen in table 2, the percentage of correct comprehension questions are orded. By comparing the data on the table 2, one can easily find out that the correctness percentage of subject relatives, similar to the previous research studies on other language learners of other nationalities such as Chinese and Spanish language learners, is signifacntly higher than that of object ones, regardless of the fact that they are subject modifying or object modifying. In addition to this, it could be observed that the accuracy of subject modifying relatives is higher than that of the object modifying ones. Interstingly, this is in accordence with the results that concluded from previous studies done on native English speakers.

### Latency (Response time)

As the study meant to, the concept of latency is a significant factor that is to be considered in this experiment. The researchers mainly concentrated on the response time of six positions in the sentences, beginning from the head noun of the relative clause. The time spent on each position and the standard deviations are shown in table 3.

*Table 2. Accuracies of Conprehension Questions*

| Subject –Subject modifying relative clauses | Subject-Object modifying relative clasuses | Object-Subject modifying relative clauses | Object-Object modifying relative clauses |
|---|---|---|---|
| 69.17% | 65.34% | 60.34% | 49.91% |

Table 3. Response times (in millisecond) plus their standard deviations

| | *the* | | *head noun* | | *that* | | *P1* | | *P2* | | *P3* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | Std. | mean | Std. | mean | Std. | mean | Std. | mean | Std. | mean | Std. |
| S-SR | 441 | 151 | 672 | 459 | 538 | 318 | 828 | 540 | 504 | 354 | 808 | 589 |
| S-OR | 450 | 151 | 691 | 648 | 554 | 341 | 470 | 254 | 857 | 730 | 847 | 516 |
| O-SR | 473 | 257 | 668 | 415 | 577 | 423 | 741 | 379 | 535 | 281 | 801 | 524 |
| O-OR | 469 | 304 | 702 | 492 | 602 | 379 | 531 | 401 | 818 | 625 | 819 | 549 |

Having measured and listed the response time of each position, the researchers drew a comparison between subject relatives and object relatives employing Oneway ANOVA. Initially, the concepts and data belonging to S-SRs and the S-ORs were studied. Drawing on the results, it was demonstrated that when the participants read the word "the", $F(1) = 0.638$, $p > 0.05$, the difference occurred was actually insignificant. When the participants reached the head noun, $F(1) = 0.164$, $p > 0.05$, the difference which occured was not significant. The same thing occured at the next position "that", $F(1) = 0.208$, $p > 0.05$. Afterwards, the following postion was studied "P1", it was illustrated that $F(1) = 62.133$, $p < 0.05$, the existing difference was actually significant. As well as this, the next position "P2" demonstrated a significant difference, with $F(1) = 35.471$, $p < 0.05$. Additionally, at the last position "P3", $F(1) = 0.368$, $p > 0.05$, the occuring difference was insignificant. Using the same method, the researcher studied the O-SRs and the O-ORs as well. Results were again quite alike. When it came to the position of "the", $F(1) = 0.037$, $p > 0.05$, difference was not of significance. Next, at the position of head noun, $F(1) = 0.583$, $p > 0.05$, the existing difference was not significant, either. The same thing took place in the following position "that", with $F(1) = 0.265$, $p > 0.05$. Significant differences began at the next two positions, namely "P1" and "P2", demonstrating the following data $F(1) = 28.491$, $p < 0.05$ and $F(1) = 31.829$, $p < 0.05$. At the lastposition P3, $F(1) = 0.016$, $p > 0.05$, which shows that the difference was not significan, either.

## DISCUSSION

It was clearly mentioned at the beginning of the paper that English subject preference is supported by many experiments done on native speakers of English. In this study, we concluded that the same tendency exists among Iranian learners of English as well. As it was shown in the result section, the subject preference is also applicable to Iranian learners at both level of accuracy of comprehension questions and response time of relative clauses. The explore the possibile reasons of this phenomenon and its seeming universality, different well-established theories are presented by the researcher that can explain the results of this research.

As a matter of fact, the results of the current study which was conducted in EFL context among iranian students of Enngliish at advanced levels, are justifuable based on frequency based theories, role shifting based theories, distance-based theories, and universality based theories.

Gibson (1998) worked on a theory of the relationship between the sentence processing mechanism and the available computational resources, which was called the Syntactic Prediction Locality Theory. There are two components included in this theory, one is the integration cost component ,and the other is the memory cost related to keeping track of non-optional syntactic requirements component. As said by Gibson (1998), both the integration cost and the memory cost are heavily affected by locality, which is to say, the longer the distance between an incoming word and the head word is, the greater the integration cost; and the longer a predicted category needs to be kept in the sort-term memory ,thus the greater the memory cost. So, it can be said that a longer filler-gap distance of object relatives results in a higher memory cost with more predicted syntactic categories in memory plus a higher level of integration cost with longer distance of attachment. This, is actually a distance-based theory which can easily explain the exisiting subject preference among Iranian learners of English. It can be said that two noun phrases of the same type in one sentence can influence the reader's comprehension process. For instance, let's look at the examples which were actually taken from the questions given to the participants.

1. The guy that argued with his brother talked to his friend and killed him.
2. The guy that his brother argued with talked to his friend and killed him.
3. The friend talked to the guy that argued with his brother and killed him.
4. The friend talked to the guy that his brother argued with and killed him.

Considering these examples, in sentence (3), "his brother" and "him" are from the same group. We can obviously see that the short distance between the two words are short ,relative to the number of the words in the sentence. However, in sentence (4), we can see the distance between the two words "guy" and "him" is 7 words, which is ,comparatively, very long. This leads to a higher nuber of mistakes when it comes to understanding the relative clause as well as processing the sentence.

As it is known, some of the theories about the English subject preference are actually based on a number of universal features of the language. Scholars assume that the universality of language is also held responsible for the language choice preferences to some extent. The concept of Canonical Word Order is a theory ,discussed by MacDonald and Christiansen (2002), is relevant to the results acquired by the researchers of this paper. From their point of view,

since the basic word order in English is S-V-O, a relative clause with the same order is easier for the reader to understand. For example, in example (3), the word order of subject relatives is S-V-O ("The friend talked to the guy"), which is actually parallel with the canonical English word order and also the first part is also similar to the existing word order in Farsi (S-V). On the other hand, this order turns to be that of O-S-V in the object relatives ("the guy that his brother argued with"). The change of the word order makes it more time consuming, as it is shown in the time delay investigation, in the sentence comprehension process.

If we are to explain the subject preference among Iranian learners of English in terms of Role-shifting based theories, scholars have noticed that certain shift can happen to the role of the head noun in an object relative. It should be mentioned in the Parallel Function Account which was established by Sheldon (1974). He argued that the shifting of the role of the head noun in an object relative made it harder to process and understand. For instance, in the above sentence (3), the head noun "friend" acts as the subject of the matrix clause in all of the mentioned sentences.

One other posiibilities, the first one which appealed to the researcher by a review of the related literature, justifying subject preference among learners of English language is known to be the high frequency of subject relatives when we compare them with object relatives. Researchers, having checked in language corpus, found that subject relatives are much more frequently used than object relatives. Therefore, it is argued that subject relatives are actually easier for participants to process since they are ,comparatively, more familiar with this kind of relative clauses. The writers of this paper are well convinced that the more one reads and encounbters with subject relatives, the easier they find it to process. Now, it can be clearly said that this frequency based theory is applicalble tp Iranian English learners.

## CONCLUSION

Having conducted a self-paced reading experiment using Linger software and then analyzing the acquired data by SPSS, the researchers of this paper came to the conclusion that, quite like English native speakers, English subject preference is also applicable to Iranian English learners. The results illustrated that Iranian English learners would spend significantly less time processing English subject relative clauses when compared with object relative clauses. In order to investigate the reasons for which English subject preference is found among Iranian English learners, in the discussion part, we reviewed some theories proposed by previous researchers and relevant to the results of this study. Having drawn an analogy between structure of sentences in Farsi and English, the researchers came to the conclusion that the higher frequency of subject relative clauses, universality of cononical word order, parallel functioning as well as integration and memory cost may be proposed as possible explanations for the facts observed in the study. One more noteworthy point found by the reseachers was the fact that subject relative clauses appeared to be processed faster than object relative ones. To put it in a nutshell, the results of this study are expected to contribute to the establishment of universal structures in languages all over the world. Moreover, the results might be beneficial for the development of laguage materials and designing programs in which grading and sequencing of the materials in terms of difficulty is of crucial importance.

## DECLARATIONS

### Authors' contribution

All authors contributed equally to this work.

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### Competing interests

The authors declare that they have no competing interests.

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