



THE EFFECT OF RELATIVE CLAUSE TYPES ON PROCESSING DIFFICULTY

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ABSTRACT

This study investigated processing difficulty of relative clauses in two groups of Persian-speaking students with high and low level of English proficiency. 165 (92 female) university students aged 18 to 30 were recruited for this study. They answered to sentence comprehension task consisted of four types of restrictive English relative clauses, namely, SS, SO, OS, and OO. The results showed that participants faced less processing difficulty in OS and OO type. In contrast, they experienced the most processing difficulty in SS type. Determining factor in relative clause processing by Persian-speaking participants was the position of relative clause within the matrix clause (embeddedness) rather than the role of the head noun in the relative clause (focus). Moreover, proficiency level of participants did not bring about a drastic change on the relative clause processing. The result of this study provided strong evidence for Perceptual Difficulty Hypothesis (Kuno, 1977), Non-interruption Hypothesis (Slobin, 1973), and Word Order Difference Hypothesis (Bever, 1970).

KEY WORDS: Embeddedness, Focus, Relative clause, Processing difficulty

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INTRODUCTION

Relative clauses have been extensively studied from several perspectives (Brandt, Diessel, and Tomasello, 2008; Brown 1971; Demberg and Keller, 2008; Diessel and Tomasello, 2000, 2005; Friedmann, 2008; King and Just, 1991; McKee and McDaniel, 2001; Reali and Christiansen, 2006). Relative clauses (henceforth, RCs) are useful in investigating the underlying rules, strategies, and constraints on sentence comprehension (Fedorenko, Pitantadosi, and Gibson, 2012). Hamburger and Crain (1982) reported that RCs play a central role in natural language. Acquisition of relative clauses shows learner's mastery of recursion and their ability to use and understand non-local dependencies (Kidd, 2011). Furthermore, recursion, that is embedding

one instance of category inside another instance of category to generate an infinite number of structures, is one of the most important features of RCs that has led them to be at the center of psycholinguistic studies (Gibson, Desmet, Grodner, Watson, and KO, 2005). Psycholinguistics have focused on restrictive relative clauses among the different types of RCs. Sentences with restrictive relative clauses are a type of complex structures that has been proven to be useful for studying language processing (Gordon, Hendrick, and Johnson, 2001). Among the various types of restrictive RCs, this study only investigates those RCs that the role of their matrix clause is either subject or object and the role of the extracted noun in the relative clause is either subject or object. In other

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words, two head nouns (subject and object) and two relativized noun phrases, yielding a total of four types of RC, namely, SS, SO, OS, and OO have been taken into account in this study. An example of each type taken from Comrie (2002) is as follows:

- SS: The man [that saw the rabbit] caught the fox.
SO: The fox [that the man saw] caught the rabbit.
OS: The man saw the fox [that caught the rabbit].
OO: The fox caught the rabbit [that the man saw].

Psycholinguistic researchers have focused on these four types of full restrictive relative clauses. MacWhinney and Pleh (1988) claimed that these four types of restrictive RCs consist of three important determining features: (a) variation in the role of the head in the matrix clause, (b) variation in the role of the head in the relative clause (c), and the position of the relative clause. Relative clauses are classified based on two important features: one is 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, also called embeddedness). If the subject of the matrix clause is modified it is called *center-embedded*, while if the object of the matrix clause is modified it is called *right-branching*. The other feature is the syntactic role of the element that is gapped or relativized inside of the relative clause (also called the focus of the relative clause). Based on these two features, four types of relative clause are usually classified: SS, SO, OS, and OO. They are identified by a two-letter acronym. The first letter describes the grammatical function of the head noun in the matrix clause and the second letter describes the grammatical function of the gap in the relative clause. SS and OS type are referred to as *subject-extracted relatives (SRC)* and OO and SO types as *object-extracted relatives (ORC)*. Subject-modifying relatives (center-embedded) refer to SS and SO types; object-modifying relatives (right-branching) refer to OS and OO types.

Among the different perspectives of relative clauses the contrast between the processing of SRC and ORC has been frequently studied to gain a better understanding of sentence processing (Johnson,

Lowder, and Gordon, 2011). A well-established result of these studies is that the processing of SRC as in (1a) is less demanding than ORC as in (1b) (Arosio, Adani, and Guasti, 2005; Frauenfelder, Segui, and Mehler, 1980; Frazier, 1987; Gordon et al., 2001; Hsiao and Gibson, 2003; Ishizuka, Nakatani, and Gibson, 2003; King and Just, 1991; Kwon, Polinsky, and Kluender, 2006; MacWhinney and Pleh, 1988; Miller and Isard, 1964; Mak, Vonk, and Schriefers, 2002, 2006; Reali and Christiansen, 2006; Waters and Caplan, 2001). Examples are adopted from Gibson (1998, p. 2).

- (1) a. The reporter [that ___ attacked the senator] admitted the error.
b. The reporter [that the senator attacked ___] admitted the error.

Numerous studies have attempted to account for the processing difficulty of ORC, but due to the different methodologies and perspectives there is no consistent results and accounts for the difficulty of ORC (Bowerman, 1979). Therefore, different processing hypotheses have been proposed to explain the difference between SRC and ORC. In the first set of hypotheses, as Noun Phrase Accessibility Hypothesis (NPAH) and Relativized Subject Accessibility (RSA), function of the relative pronoun is a determining factor on the processing difficulty. The NPAH is a typological generalization on the relativization possibility of grammatical functions obtained through an investigation of relative clause formation strategies in 50 languages. Based on the NPAH proposed by Keenan and Comrie (1977), grammatical functions (subject, direct object, indirect object, object of preposition, and object of comparison) are universally ordered in a hierarchy as in (2) in which the subject is placed higher than object and other grammatical functions.

- (2) Subject > Direct object > Indirect object > Oblique > Genitive > Object of comparison

The symbol > indicates *is more accessible than*. Example of each RC type adopted from Hamilton (1994) is as follows.

- (3) Subject RC: the man [that __ knows the woman]
- (4) Object RC: the man [that the woman knows __]
- (5) Indirect Object RC: the man [that the woman gave a pencil to __]
- (6) Object of preposition RC: the desk [that the woman put the pencil on __]
- (7) Genitive RC: the man [whose pencil the woman took __]
- (8) Object of Comparison RC: the man [that the woman is taller than __]

The higher place of subjects in this hierarchy makes them more accessible and leads to less processing difficulty. That is, relativizing constituents towards the right of the hierarchy results in more marked structures and relativizing constituents towards the left of the hierarchy results in less marked structures. Therefore, relative clauses formed on subject are hypothesized to be the easiest and those on the object of comparison are the most difficult. Keenan and Comrie (1977) did not take into account the functions of the relativized noun in the matrix clause. The NPAH is only concerned with the functions of the relativized pronoun in the relative clause. While a wide number of studies found their results in line with the NPAH (Diessel and Tomasello, 2000, 2005; Doughty, 1991; Eckman, Bell, and Nelson, 1988; Gass, 1979; Gibson et al., 2005; Hamilton, 1994; Ishizuka, 2005; Pavesi, 1986; Rahmany, Marefat, and Kidd, 2011), other studies found that the NPAH is not able to account for the relativization in ergative languages (Hsiao and Gibson, 2003; Hsiu-chuan, 2000; Ozeki and Shirai, 2007). Keenan (1975) proposed Relativized Subject Accessibility (RSA) Hypothesis in which relativized subjects are more accessible than relativized objects. Therefore, according to this hypothesis, SS and OS types are predicted to be easier than SO and OO. In the second set of hypotheses, as in Non-interruption Hypothesis (NIH), Perceptual Difficulty Hypothesis (PDH), and SO Hierarchy Hypothesis (SOHH), interruption of the matrix clause by the RC is the cause of the processing difficulty. Slobin (1973) proposed Non-interruption Hypothesis and asserted that "based on the universal principle of

surface preservation of underlying structure, interruption or rearrangement of linguistic units places a strain on sentence processing—both in production and reception" (Slobin, 1973, p. 199). Parsers prefer to reserve the underlying structure of linguistic unit in their surface manifestations. Slobin (1973) claimed that interruption or rearrangement of linguistic units should be avoided and the tendency to preserve the structure of the sentence as a closed entity results in the development of sentence-final relative clauses as in (9a) before than embedded relative clause as in (9b). Examples are taken from Slobin (1973).

- (9) a. I met a man who was sick.
b. The man who was sick went home.

Non-interruption Hypothesis (NIH) which can be applied to a matrix sentence as an anti-interruption constraint and to an RC as preference for canonical word order is based on Closure and Normal Form Strategies. As OS and OO (non-interrupted) RCs allow early closure and can be processed by the NVN strategy, they are easier than SS and SO (interrupted) RCs.

Based on Perceptual Difficulty Hypothesis proposed by Kuno (1974), center-embedded RCs are more demanding than right-branching ones. Kuno (1974) asserted that parsers face greater difficulty in comprehension of center-embedded RCs due to the interruption of the matrix clauses by RC. The interrupted matrix clause is kept in the short memory until the interpretation of the embedded clause is finished, which adds burden to the memory capacity and causes perceptual difficulty. Kuno (1974) reported that short-term memory is an important determinant in RC processing. Doughty (1991), Flanigan (1995), Ioup and Kruse (1977), Prideaux and Baker (1986), and Schumann (1980) found consistent results with the PDH. Hamilton's SO Hierarchy Hypothesis (1994) examines both the function of the head noun in the matrix clause and the function of the relative pronoun in the relative clause. In other words, it is a combination of two hypotheses, the NPAH and the PDH (O'Grady, 2003). This hypothesis is based on the notion of processing discontinuity. Izumi (2003) defined processing

discontinuity as the interruption of the matrix clause by the RC and also by phrasal boundaries within the RC that separate the relative pronoun and the trace created by relativization. Therefore, center-embedding creates one discontinuity, relativized subject creates one discontinuity, and relativized object creates two discontinuities. The difficulty order in this hypothesis is determined by the number of discontinuities and predicts the following order: OS > OO/SS > SO. OS contains only one discontinuity. OO and SS contain two discontinuities. SO contains three discontinuities. Each RC type in (10) shows the number of discontinuities. Examples are taken from Sheldon (1977). The letter (t) indicates wh-trace and (i) indicates co-index. (10)

OS (1 discontinuity): The boy hit the man that _i [IP t_i saw the girl].

OO (2 discontinuities): The boy hit the man that _i [IP the girl [VP saw t_i]].

SS (2 discontinuities): The boy [that _i [IP t_i saw the girl]] hit the man.

SO (3 discontinuities): The boy [that _i [IP the girl [VP sees t_i]]] hit the man.

MacWhinney and Pleh (1988) proposed Perspective Shift Hypothesis (PSH) and referred to the role of subjects in determining the perspective of a clause due to the inherent saliency of subjects to objects. They asserted that when the process of perspective sharing is disrupted by interruptions, monotony, excessive complexity, or lack of shared knowledge, communication can break down. Therefore, when the perspective of a clause is taken from the subject of the clause processing resources are required. SO type requires two perspective shifts: 1. from the perspective of the matrix subject to the subject of the RC and 2. from the perspective of the RC back to the matrix subject; after the RC is processed. Because the matrix subject is also the subject of the RC, processing of SS RC requires no perspective shift. For each of the OS and OO type, there is one shift. Based on the PSH, the order of difficulty for the four English RCs is: SS > {OO = OS} > SO. The symbol > indicates *is easier than*. Parallel Function Hypothesis (PFH) proposed by Sheldon (1974) takes into account the function of noun phrase (NP) as the cause of processing difficulty. Sheldon (1974)

claimed that when the head NP of the relative clause plays the same grammatical role in both the matrix clause and the relative clause as in SS and OO, it is easier to comprehend than those relative clauses that the head NP have different grammatical role in the matrix clause and the relative clause as in SO and OS type. Different studies found inconsistent results with the PFH (Bowerman, 1979; Gass and Ard, 1980; Ozcan, 1997; Ozge, Marinis, and Zeyrek, 2010; Prideaux and Baker, 1986; Sadighi, 1994; Sheldon, 1977; Tavakolian, 1977).

In addition to the mentioned hypotheses, structure-dependent hypotheses as Linear Distance Hypothesis, Structural Distance Hypothesis, and Word Order Difference Hypothesis account for more processing complexity of object relatives than subject relatives. The underlying principle in Linear and Structural Distance Hypotheses is the distance between filler-gap dependencies. The longer the distance between the filler and the gap, the complexity of the processing is more. In the Linear Distance Hypothesis, the distance between the filler and the gap is determined in terms of the number of the intervening words (Chomsky, 1965; Gibson, 1998, 2000; Hawkins, 1989; Tarallo and Myhill, 1983), while Structural Distance Hypothesis predicts the processing complexity in terms of the number of syntactic nodes between the filler and the gap (O'Grady, Yamashita, Lee, Choo, and Cho, 2000; O'Grady, Lee, and Choo, 2003). Therefore, the more number of intervening words and syntactic nodes between the filler and gap in object relatives than subject relatives causes processing difficulty in object relatives. Integration and storage cost two components of Syntactic Prediction Locality Theory (SPLT) are influenced by the Linear Distance Hypothesis. Gibson's SPLT (1998) accounts for the processing difficulty of object relatives due to the cost of computational resources consumed by the parsers. Object relatives require more computational resources than subject relatives. Chomsky (1988) reported that computational resources are necessary to maintain the current unintegrated syntactic structures activated in memory during sentence comprehension. The integration cost is associated with the discourse complexity of the intervening material between the

elements being integrated. Building new discourse structures is more expensive than the already constructed discourse elements.

In English, subject and object relatives have different word order. Subject relatives with canonical word order NVN are compatible with parser's previous experience of simple sentences, while object relatives with non-canonical word order NNV are contrary to the canonical word order of English simple sentences (Bever, 1970; Christiansen and MacDonald, 2009; MacDonald and Christiansen, 2002). Based on the Word Order Difference Hypothesis (Bever, 1970), any noun-verb-noun corresponding to subject-verb-object will be easier to process than the same sequence corresponding to other grammatical relations. Based on this hypothesis, OS and OO RCs are easier than SS and SO RCs because they are not interrupted and can be processed by the NVN strategy. Therefore, right-branching RCs have more canonical sequences and are easier than their counterpart center-embedded RCs (De Villiers, Flusberg, Hakuta, and Cohen, 1979; Gibson et al., 2005).

METHOD

This study aims to investigate the processing difficulty of English restrictive relative clauses to find which theories of RC processing are supported by the results of the study and also attempts to examine whether the focus or embeddedness has more important role in RC processing by Persian-speaking participants.

Participants

One hundred and sixty five (N= 165, 92 female) Persian speaking students aged between 18 and 30 participated in this study. They were studying English Literature, English Translation, and Teaching English as a Foreign Language in three universities. They received extra course credit for their participation. Based on the results of the Michigan Test of English Language Proficiency (MTELP), the participants were divided into two groups. The group of high proficiency level consisted of 82 participants, and the low proficiency group consisted of 83 participants.

Instrumentation

Participants performed the MTELP and a Sentence Comprehension Task. The Sentence Comprehension

Task consisted of 20 sentences with five items representing each of the four RC types. Half of the sentences were center-embedded (SS, SO) and half of them were right-branching (OS, OO). Center-embedded and right branching sentences were designed to examine the effect of the relativized noun phrase on sentence processing. The effect of the relativized gap (the focus) of the RCs was examined by SRC (SS, OS) and ORC (SO, OO). Different studies demonstrated that if object relatives contain a proper name, first or second pronoun, processing difficulty is reduced than ones contain a lexical noun (Chomsky and Miller, 1963; Gordon, Hendrick, and Johnson, 2004; Warren and Gibson, 2002); therefore, all the noun phrases used in Sentence Comprehension Task were definite description to avoid the effect of pronominal noun phrases on processing difficulty. In addition, to control the influence of animacy all the noun phrases were animate noun phrases as animacy of the subject or object of a clause has been shown to affect comprehension to a great extent (Arosio, Guasti, and Stucchi, 2010; Betancort, Carreiras, and Sturt, 2009; Gennari and MacDonald, 2008; Lowder and Gordon, 2014; Mak et al. 2002, 2006; Traxler, 2007; Traxler, Morris, and Seely, 2002; Wu, Kaiser, and Andersen, 2011). Animacy and reversibility of noun phrases were necessary to prevent the participants using the semantic cues without using their grammatical knowledge. That is, the logical assignment of either thematic role to both NPs in the sentence was enabled. Based on the given-new strategy of Givon (1979), differences in definiteness or indefiniteness of noun phrases influence processing difficulty; therefore, all the noun phrases were definite. All of the verbs in both the RC and the matrix clause were transitive, singular, and used in the present tense. Types of relative clauses were listed randomly in order to avoid any biased results due to the fixed order of the RC types.

Procedure

First, participants took the MTELP. Participants had to make a reasonable answer to each question in the MTELP. Then, participants answered to the Sentence Comprehension Task. Prior to the task, some training items were presented to make sure that participants knew the procedure. At this stage,

there was sufficient interaction between the experimenter and the participants to ensure they knew how to proceed. However, there was given no interaction during the actual test phase. In Sentence Comprehension Task, participants had to read each sentence and fill in the blanks of each sentence. In other words, participants had to identify the subject and object of the verb in the matrix clause and those of the verb in the RC. One example of Sentence Comprehension Task is illustrated in (12).

(12) The rabbit that the cat watches kicks the bird.

(a) [..... watches] (b)
[.....kicks.....]

In the example (12) which is a SO RC type, the blanks are referred to as positions. The first position in SO RC type is referred to as SOES, the first two letters refer to the RC type and the second two letters refer to the Embedded Subject position. The second position is referred to as SOEO, EO referring to the Embedded Object position, the third position is referred to as SOMS, MS referring to the Matrix Subject position and the last position belongs to SOMO, MO referring to the object position of the matrix clause. Students had to recognize the correct position of each RC type. The two tasks were administrated in two sessions.

RESULTS

A repeated measures ANOVA was conducted, with RC types (SS, SO, OS, OO) as the within-group variable, and proficiency level (high, low) as the between-group variable. The results showed that there was no significant interaction effect between the types of RCs and the proficiency level [$F_{(3, 161)} = 1.58, p = 0.19, \eta^2 = .029$]. There was a significant main effect for RC types [$F_{(3, 161)} = 20.84, p = .000, \eta^2 = .28$] and proficiency level of participants [$F_{(1,163)} = 5.41, p = .02, \eta^2 = .032$]. The results of pairwise comparisons showed that participants' performance did not differ in OS (Mean= 4.58) and OO type (Mean= 4.47), but their performance in OS and OO type was better than SO (Mean= 4.16) and SS type (Mean= 3.78).

Different repeated measures ANOVA were conducted to find the performance of the participants in each position of RC types as well. Therefore, the results of repeated measures ANOVA

showed that there was no significant interaction effect between the positions of SS RC and the proficiency level [$F_{(3, 161)} = .59, p = .62, \eta^2 = .01$]. There was significant main effect for positions of SS RC type [$F_{(3, 161)} = 4.18, p = .000, \eta^2 = .43$] and proficiency level of participants [$F_{(1,163)} = .92, p = .33, \eta^2 = .006$]. The results of pairwise comparison showed that participants' performance did not differ in identifying object of the matrix clause (SSMO, Mean= 4.95), object of the embedded clause (SSEO, Mean=4.89), and subject of the embedded clause (SSES, Mean= 4.87), but their performance in identifying SSMO, SSEO, and SSES was better than subject of the matrix clause (SSMS, Mean= 3.88).

The results of repeated measures ANOVA for positions of SO RC type revealed that there was no significant interaction effect between RC types and proficiency level of learners [$F_{(3, 161)} = 1.28, p = .28, \eta^2 = .023$]. There was significant main effect for positions of SO RC type [$F_{(3, 161)} = 22.09, p = .000, \eta^2 = .29$] and proficiency level of participants [$F_{(1,163)} = 3.88, p = .05, \eta^2 = .023$]. The results of pairwise comparisons showed that participants' performance did not differ in identifying subject of the matrix clause (SOMS, Mean= 4.55), subject of the embedded clause (SOES, Mean= 4.53), and object of the embedded clause (SOEO, Mean= 4.41), but their performance in object of the matrix clause (SOMO, Mean= 4.97) was better than SOMS, SOES, and SOEO.

The results of repeated measures ANOVA for positions of OS RC type revealed that there was no significant interaction effect between the OS positions and the proficiency level [$F_{(3, 161)} = 1.71, p = .16, \eta^2 = .031$]. There was significant main effect for positions of SO RC type [$F_{(3, 161)} = 13.44, p = .000, \eta^2 = .20$]. The main effect comparing two groups of learners was not significant [$F_{(1,163)} = .29, p = .58, \eta^2 = .002$]. The results of pairwise comparisons showed that participants' performance did not differ in identifying subject of the matrix clause (OSMS, Mean = 4.99), object of the matrix clause (OSMO, Mean= 4.98), and object of the embedded clause (OSEO, Mean= 4.95), but their performance in OSMS, OSMO, and OSEO was better than subject of the embedded clause (OSES, Mean=4.61).

The results of repeated measures ANOVA for positions of OO RC type revealed that there was significant interaction effect [$F_{(3,161)} = 3.091, p = .04, \eta^2 = .037$], significant main effect for positions of OO RC type [$F_{(3, 161)} = 24.14, p = .000, \eta^2 = .23$], and proficiency level of participants [$F_{(1,163)} = 7.86, p = .006, \eta^2 = .046$]. The results of pairwise comparisons showed that participants' performance did not differ in subject of the matrix clause (OOMS, Mean= 4.98) and object of the matrix clause (OOMO, Mean= 4.98), but their performance in OOMS and OOMO was better than subject of the embedded clause (OOES, Mean= 4.57) and also their performance in OOES was better than object of the embedded clause (OOEO, Mean=4.49).

A paired samples t-test was run to compare the effect of embeddedness vs. focus on RC processing. The results showed that there was significant difference between embeddedness [$M = 1.55, SD = 1.45$] and focus [$M = 1.22, SD = 1.59, t(164) = 2.47, p = 0.01$ (two-tailed)]. Furthermore, other paired samples t-test was conducted to see whether the difference between right-branching and center embedded RCs was significant. The results showed that there was a statistically significant difference between right-branching RCs [$M = 9.05, SD = 1.35$] and center embedded RCs [$M = 7.94, SD = 1.99, t(164) = 7.73, P = .000$ (two-tailed)]. The results of the third paired samples t-test showed that there was significant difference between SRC [$M = 8.36, SD = 1.64$] and ORC [$M = 8.64, SD = 1.77, t(164) = 1.936, p = .05$ (two-tailed)].

DISCUSSION

This study found the following order of processing different RC types: OS and OO > SO > SS. The easiest type was OS and OO. The most difficult one was SS. This order was in line with the Perceptual Difficulty Hypothesis of Kuno (1974) and Non-interruption Hypothesis of Slobin (1977) in which the SS and SO type are the most demanding RC types for learners to process due to the interruption of the matrix clause by the relative clause. The interrupted matrix clause is kept in the short term memory until the interpretation of the embedded clause is finished, which adds burden to the memory capacity and causes perceptual difficulty. Participants had a better performance on

right-branching structures as OS and OO RC type. Slobin (1977) reported that right branching structures do not require the rearrangement of linguistic units to be understood and place no strain on processing. The non-interrupted matrix clause in OS and OO RC allows early closure as it precedes right-branching RC. Parsers' tendency to preserve the structure of the sentence as a closed entity leads in their better performance of the OS and OO RCs. Chomsky (1965), Miller and Isard (1964), and Izumi (2003) also reported that center-embedded RCs are more demanding than right-branching counterparts. Other reason for the difficulty of center-embedded RCs may be due to the more syntactic memory or storage cost that they require for processing (Chomsky and Miller, 1963; Gibson, 1998). Integration cost of Gibson's Syntactic Prediction Locality Theory (2000) accounts for the difficulty of center-embedded structures. The distance integration between syntactic nodes is longer in the center-embedded structures. The result of this study partially supports Hamilton' (1994) SO Hierarchy Hypothesis. The SOHH takes into account the notion of discontinuity in processing difficulty and predicts OS type as the easiest which is supported by the finding of this study. Although SO RC type was demanding for learners in comparison with OS and OO type, SS RC was the most difficult which was contrary to the SOHH. The results of this study run contrary to the Perspective Shift Hypothesis. According to the PSH, when parsers process SS RC they need no perspective shift from the matrix subject. In contrast, in SO type parsers must change the perspective of the matrix subject to the embedded subject and again shift back to the matrix subject from the embedded subject after the RC is processed. Although this study found the superiority of OS and OO type over SO consistent with the finding of the PSH, the most difficulty in SO type was not supported. The results of this study found SS type as the most difficult type. The Parallel Function Hypothesis did not receive support from the findings of this study as well. According to Sheldon (1974), the best performance of parsers must be on SS and OO types due to the same grammatical role of the head NP in both the matrix clause and the relative clause. Participants of this study had a better

performance on OO RC type rather than SS one. It seems that co-referential NPs with the same grammatical function in their respective clauses have no effect on relative clause processing. The results of the study also had conflicting results with the NPAH and RSA. In addition to investigating the difficulty order of RC types, participants' performance on the positions of RCs namely, Matrix Subject, Matrix Object, Embedded Subject, and Embedded Object have been taken into account. Both high and low proficiency groups had the worst performance in identifying SSMS, SOMS, SOES, SOEO, OSES, OOES, and OOEO. The easiest positions were SSMS, SOMO, OSMS, OSMO, OOMS, and OOMO. The most demanding RC type for Persian speaking EFL learners was the SS type due to the difficulty in identifying SSMS (Mean=3.88). It seems that due to the embedding of RC within the matrix clause, participants misinterpret the object of the RC as the subject of the matrix clause. That is, in a SS type such as *the pig [that kicks the cow] pushes the dog*; participants misinterpret the cow as subject of the verb *pushes*. This result is inconsistent with predictions of Sheldon (1974) and also Tavakolian (1977). According to Sheldon, participants have the best performance in identifying SSMS position due to the same grammatical role of the pig in both the matrix and relative clause. Tavakolian reported that participants have no problem in identifying SSMS because SS type is interpreted as two conjoined clauses. This finding also did not support O'Grady's claim (1977) that object gap is more demanding than subject gap. The results of this study found that subject gap was more difficult than object gap. The results of this study also had strong evidence for the effect of embedding in misinterpretation of SS type and also it seemed that participants' previous experience of the canonical NVN English structures affected misinterpretation of SSMS. In other words, SS type has been interpreted as OS type. The second demanding RC type for Persian speaking EFL learners was the SO type due to the difficulty in identifying SOEO, following by SOES and SOMO. That is, in a SO type such as *the rabbit [that the cat watches ___] kicks the bird*, participants could not make association between *the rabbit* and the verb *watches* due to the embeddedness of an RC within the

matrix clause. Participants interpreted *the cat* as object of the verb *watches* rather than the subject of the verb *watches*. In OO type as in SO type participants had greater difficulty in identifying the embedded object. In a sentence, *the postman meets the man [that the worker helps ___]* participants made the same mistake in identifying the object of the verb *helps* as in identifying the object of the verb *watches* in SO type. *The rabbit [that the cat watches ___] in SO type and the man [that the worker helps ___] in OO type* are object relatives. The difficulty of object relatives rather than subject relatives has been reported in the Word Order Difference Hypothesis, Filler-gap Dependency, NPAH, Syntactic Prediction Locality Theory, Structural Distance Hypothesis, and Linear Distance Hypothesis. The longer distance, the more intervening syntactic nodes, and the more number of intervening words between the filler and gap compared to subject relatives accounts for the difficulty of object relatives. Furthermore, the absence of resumptive pronoun in English objects relatives may explain the difficulty of object relatives for Persian-speaking participants. A comparison between English and Persian RC shows that using resumptive pronoun is allowed in Persian RC, but not in English RC. Rahmany, Marefat, and Kidd (2013) found the facilitative role of resumptive in their study of Persian-speaking children's comprehension of object relatives. They reported that children's comprehension of object relatives containing a resumptive pronoun was improved than children's comprehension of gapped objects and subject relatives. They asserted that resumptive pronouns provide local cues to thematic role assignments and facilitate processing of syntactically complex sentences. Therefore, it can be concluded that participants of this study faced greater difficulty in interpreting object relatives due to the fact that there is no resumptive pronoun in English. In OS type which was the easiest type as *the girl kicks the cat [that pushes the rabbit]*, all participants could identify the subject and object of the matrix clause. It seems that simple canonical English structure in OS type facilitates processing. Furthermore, participants' processing of OS type supports the conjoined clause analysis of Tavakolian. That is,

participants processed the sentence as two separate clauses *the girl kicks the cat* and *the cat pushes the rabbit*, a finding which further supports the linear nature of RC processing.

CONCLUSION

First, the results of this study found strong evidence for superiority of object-modifying relatives over subject-modifying relatives. That is, participants processed right-branching sentences better than center-embedded ones. Second, it was found that ORCs were less demanding than SRCs. This result was not consistent with the NPAH and the RSA. Third, this study compared the effect of focus and embeddedness on processing difficulty and found that the position of relative clause within the matrix clause (embeddedness) was a determining factor in RC processing by Persian-speaking students. That is, when RCs were placed within the matrix clause, participants faced more difficulty in sentence processing. Furthermore, this study investigated participants' performance in each position of RC types to better account for the processing difficulty participants faced with. It was found that the most important reasons for misunderstanding the RC types was due to the interruption of matrix clause by the RC and participants' previous experience with simple English sentences. Therefore, the results of this study provided strong evidence for the Perceptual Difficulty Hypothesis of Kuno (1974), Non-interruption Hypothesis of Slobin (1977), and Word Order Difference Hypothesis (Bever, 1970).

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