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EFL Learners' Production of Relative Clause Structure: Evidence from Priming Effect

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Abstract

Priming has become increasingly prevalent in applied linguistics. It has recently been used in language teaching as the speakers' tendency to reuse the same structure they encounter in previous discourse on subsequent production. The present research investigated whether priming lead to EFL learners' possible short- and long-term improvement in producing relative clause (RC) structure. Participants comprised 40 intermediate female language learners with an average age of 18-25 years old. They were chosen through cluster sampling from a pool of 70 language learners and assigned to an experimental group (20) and a control group (20). The needed data was gathered through a grammatical judgment test and a picture description task. The results revealed that learners' production descriptively improved shortly after priming intervention and similarly in the long run. However, no significant improvement was inferentially observed in short- and long-term production of relative clause structure. The results were discussed in terms of structural complexity, learners' current state of knowledge, and their proficiency levels. The findings provide insights on priming as a means of enhancing opportunities for EFL and ESL learners' grammar production.

INTRODUCTION

One of the pedagogical drawbacks commonly observed among language learners is that although they might have acquired knowledge of the grammatical structures, they still find it difficult to use those structures competently in communication (Crook, 1991). Different approaches like behaviorists, cognitivists, and sociocultural ones have been implemented in the language classes throughout the years to address this issue and educators have still been searching for the best choice to guarantee an ideal learning process (McDonough & Chaikitmongkol, 2010). From among the approaches and criteria that have been proposed, priming has recently attracted the focus of applied linguists (e.g., Jackson & Ruf, 2017; Kim & McDonough, 2016; Shin & Christianson, 2012) in order to study learners' language learning and use in a particular context. The Priming paradigm emerged in psycholinguistics, but it has become more and

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more prevalent in applied linguistics throughout the past decades. The term priming, also known as structural persistence, syntactic priming, adaptation, or alignment refers to a fact by which speakers are more inclined to produce the sentence that they heard or produced in recent discourse compared to an alternative form (Bock, 1986). For instance, it is more probable that speakers produce a passive construction instead of an active structure if they have encountered with this structure in recent discourse (Cleland & Pickering, 2006; Pickering, McLean, & Branigan, 2013). The first initial utterance that the speaker is exposed to is referred to as the prime sentence, and the subsequent sentence uttered by the speaker in the following discourse is defined as the target sentence (Leonard, 2010). Structural priming is mostly applied for the study of parallel structures like active vs. passive, direct object vs. prepositional object, phrasal verbs, direct vs. indirect speech, and etc. (McDonough & Chaikitmongkol, 2010; Shin & Christianson, 2012).

Moreover, speakers will produce the prime structure even when the prime and target utterances do not share any phonological, lexical, and semantic features (Leonard, 2010). For example, the prime sentence "The teacher gave a bad mark to the student", and the target sentence "the office worker sent her resignation letter to the manager" are irreverent with regard to their semantic, lexical, and phonological properties, but they have a similar syntactic structure (subject– verb–direct object– prepositional object), which manifests itself in priming effect. In the example mentioned above, although both sentences shared similar syntactic structures, the other syntactical components like the nouns, the verb, and prepositions completely differed between the prime and the target sentences. It shows that accessing to a recently activated structure is much easier for speakers than producing and activating a thoroughly new structure, and L2 speakers prefer to adjust their speech production to the recent experience with their language (Tooley & Bock, 2014). Ferreira and Bock (2006), clearly account how structural priming leads to language acquisition. They

claim that when L2 speakers gain a mastery of how unrelated linguistic representations pertain into one another, they will be able to produce and comprehend language. For instance, for comprehending and generating a passive construction, an L2 speaker must have gained the knowledge that specific meaning relations (patient and agent relationship) relates to particular functional aspects (oblique objects and subject), which relates to linearization of words (How noun phrases and verb phrases are ordered), and so on. They suggest that structural priming provide a condition whereby linguistic experience and, in turn, mechanism of second language development progresses.

When it comes to the significance of priming in language learning, it covers a wide variety of topics in the cognitive sciences, psychology, psycholinguistics, applied linguistics and language teaching. As McDonough & Fulga (2015) assert priming appears to be an optimal tool for exploring L2 speakers' language. The examination of priming mechanisms and the way it works help in understanding the mechanisms that help L2 acquisition and use (e.g., Hartsuiker and Bernolet, 2017; Hartsuiker & Pickering, 2008; McDonough & Trofimovich, 2009). Besides, it helps to the formation of more abstract syntactic representations (Hartsuiker & Bernolet, 2017). Even construction learning studies showed that a completely new pattern can be detected and elicited after brief exposure to low frequency input by priming (Fulga & McDonough, 2014).

However, investigation of priming effect on EFL learners' production of grammatical structures in general and RC structure in particular appears to be an under-researched issue. If the main concern of priming is how the L2 speakers learn, internalize and remember linguistic materials, and so is language teaching, it is natural to ask if priming relates to language learning and development or not. Based on Usage-based approaches of language teaching, difficulties in L2 speech production stems in part from either a lack of automaticity or implicit knowledge in production (Segalowitz & Hulstijn, 2005) or a lack of well-embedded abstract syntactic knowledge (Ellis, 2005). It has been argued that priming is

influential in both the development of abstract syntactic knowledge and in the improvement of implicit, procedural knowledge (Dell & Chang, 2014). By increasing the number of inputs, priming gradually strengthens linguistics representations (Leonard, 2010; Tooley & Bock, 2014). As Ferreira (2003) claim, priming tries to tune or adjust language learners' linguistic preferences as the function of experience. However, the number of studies on the effectiveness of priming in an EFL context and on the RC structure is quite rare. This study sought to investigate the role of priming on RC production among Iranian EFL intermediate language learners.

REVIEW OF LITERATURE

Since the late 1990s, many theoretical and empirical aspects of priming have been investigated. (See Pickering and Ferreira, 2008; Mahowald, James, Futrell, & Gibson, 2016). In the following, theoretical background, empirical verification, and major contributions of priming are described respectively.

Theoretical Framework

Three main theoretical frameworks have been proposed to elucidate the priming paradigm: the lexicalist residual activation theory (Pickering & Branigan, 1998), implicit learning theory (Bock & Griffin, 2000; Chang, Dell, & Bock, 2006; Chang, Dell, Bock, & Griffin, 2000), and multi-factorial theory (Ferreira & Bock, 2006; Hartsuiker, Bernolet, Schoonbaert, Speybroeck, & Vanderelst, 2008). Each one will be described in turn.

The lexicalist residual activation assumes that priming occurs due to residual or temporary arousal or activation of the structure of the preceding sentence (prime sentence) in explicit memory. This leads to the reuse of this structure in a subsequent sentence (target sentence). It posits that the explicit memory of surface structures will lead to structural repetition (Bock & Griffin, 2000; Chang et al., 2006; Hartsuiker et al., 2008). Prime sentences, therefore, play a retrieval role in helping language users' recall and reuse of these sentences from memory.

The implicit learning account is founded on empirical evidence showing that the priming effect lasts for several trials (Bock and Griffin, 2000; Chang et al., 2006; Hartsuiker et al., 2008) over 20 minutes (Boyland & Anderson, 1998), or after training (Kaschak & Borreggine, 2008). Advocates of this account claim that it is a form of implicit learning because structural priming typically takes place outside of learners' awareness (Bock, 1982) and there is a procedural and unintentional tendency for syntactic structures to be reused (Bock & Griffin, 2000). Finally, the multi-factorial framework (Ferreira & Bock, 2006; Hartsuiker et al., 2008) holds that priming fall under the influence of both short-lived priming effects in explicit memory and long-lived implicit learning processes. Based on this account, both residual activation in explicit memory and implicit learning processes are considered as the priming effects (Bernolet, Collina, & Hartsuiker, 2016). The view claims that long-term priming inspires implicit learning mechanisms, as discussed above. However, the impact of explicit memory mechanisms on priming impresses short-term priming, especially when a lexical component is shared between the prime and target sentences, the retrieval of the surface structure of prime sentence on subsequent production becomes easier (Branigan & McLean, 2016).

As to the theoretical approaches explained above, this study inspires from the contribution of implicit learning theory in priming research. Implicit learning is defined (Ellis, 2005) as incidental adaptation of learners' processing system which happens unintentionally as the function of experience. Since the speakers' tendency for reusing of previous sentence structure of prime in subsequent production happens without conscious awareness and intention, priming can be associated with implicit learning of syntactic structure (Conroy & Mendez, 2015). It is believed that priming mechanisms match the criteria of implicit learning, so it is considered as a form of implicit learning. The criteria are syntactic processing occurs outside of awareness of L2 speakers (Bock, 1982), and the structural repetition is unintentional and procedural (Bock & Griffin,

2000). (See structural priming as an example of implicit learning within the language production system in Bock & Griffin, 2000; Ferreira, Bock, Wilson, & Cohen, 2008).

Empirical Evidence

A large body of studies have been conducted to investigate the role of priming on second language acquisition (Branigan and Messenger, 2016; Chang et al., 2006; Dell & Chang, 2014; Kaschak, Kutta, & Coyle, 2014); however, the results have been mixed, limited, and somewhat controversial. For example, Kaschak et al. (2014) conducted a series of six experiments that explored the priming effect over the course of a week using picture description and written stem completion tasks based on Prepositional Object (PO) and Direct Object (DO) constructions. They evaluated the degree to which priming persisted when a task change occurred between different phases of the study. The results showed both an immediate and long-lasting priming effect even in case of task change.

Some other studies (e.g., Branigan and McLean, 2016; Bernolet et al., 2016; Segaert, Wheeldon, and Hagoort, 2016) also explored the effectiveness of priming when the prime and the target sentences are lexically unrelated and found that priming effects accumulate over time. In a similar vein, abundance of research shows that priming effect can last at least for a week (Bernolet, Hartsuiker & Pickering, 2013; Kaschak, Kutta, & Schatschneider, 2011). Shin and Christianson (2012) explored the internal cognitive processes of L2 learners in structural priming. This was the first study that tried to compare explicit and implicit instruction in the priming paradigm. Their findings demonstrated that when explicit instruction was combined with structural priming, it was more helpful in providing a short-term improvement than instances where implicit instruction alone was used in the form of structural priming. However, because the delayed learning effect was measured only one day after the immediate post-test, the results do not provide a complete picture of the long-term effects of structural priming.

Contrary to the studies reported above, there are other studies revealing that priming is not always effective and influential in L2 learning and certain intervening factors are involved as well. For example, it has been shown that priming effect is greater when speakers are familiar with fewer number of constructions where structural competition decreases (Hartsuiker & Kolk, 1998; Pickering & Branigan, 1998), when a structure is rarely produced (Hartsuiker, Kolk, & Huiskamp, 1999; Hartsuiker & Westenberg, 2000; Scheepers, 2003), when the speakers haven't experienced a structure adequately (Nitschke, Serratrice, & Kidd, 2014), or when a mental representation of a structure is not strong enough and therefore it is more likely to change (Chang et al., 2006; Jaegerand Snider, 2013).

Besides, other L2 priming studies have reported that in case of insufficient prior knowledge of the target structure (McDonough, 2006; McDonough & Fulga, 2015) long-term priming does not occur. In addition, it has been shown that when a prime and target sentence share a lexical item like a verb, noun, or preposition, the short-term effects of priming sustain and leads to long-term priming and L2 learning. For example, McDonough & Chaikitmongkol (2010) in a study, by the use of some communicative tasks that aimed at producing wh-questions, found that there is a meaningful relationship between the number of target sentences L2 speakers produced and the sustained production of wh-questions on immediate and delayed posttests especially when there was a lexical repetition between tasks (see also McDonough and Mackey, 2008).

In addition, whether speakers repeat prime sentences aloud or not can have an influence on the magnitude of short-term and long-term priming among less-proficient L2 speakers (Jackson & Ruf, 2017; Kim and McDonough, 2016) or even more proficient ones (Chen, Jia, Wang, Dunlap, & Shin, 2013; McDonough, 2006). For example, Kim & McDonough (2016) reported that less-proficient adult L2 speakers who repeated prime sentences produced more passive sentences on immediate and two-week delayed posttests than participants who heard the prime sentence but

did not repeat it aloud (see G´amez & Vasilyeva, 2015, for similar findings with child L2 English speakers). An in depth review of the literature clearly demonstrates that most experiments about structural priming center on DO and PO structures (Kaschak et al., 2011; Kutta, Kaschak, Porcellini, & Jones, 2017; McDonough, 2006; Shin, 2010; Shin & Christianson, 2012), wh-question development (McDonough & Chaikitmongkol, 2010), dative structure (Griffin, 2000; Hartsuiker et al., 2008), transitive structure (Bock et al., 2007; Griffin, 2000), passive construction (Ameri-Golestan & Nezakat-Alhossaini, 2012; Kim & McDonough, 2008), and indirect questions and requests (Biria, Ameri-Golestan, & Méndez, 2010). Just the few experiments that centered on the relative clauses were with a focus on inter-linguistic priming between first and second language to address shared syntax hypothesis (Bernolet, Hartsuiker, & Pickering, 2007), impact of priming on relative clause processing (Wu & Juffs, 2010), and object relative clause comprehension among L2 learners (Nitschke et al., 2014). However, no study, to the best of researchers' knowledge, investigated the impact of priming on RC production. RC constructions in English have been considered to be complicated and problematic for most EFL and ESL learners, compared with some other structures in the language (Celce-Murcia & Larsen-Freeman, 1999). It has been shown that the strategy that most language learners employ when facing difficulties in RC production is avoidance strategy (Chiang, 1980; Gass, 1980; Li, 1996; Maniruzzuman, 2008; Schachter, 1974; Zhao, 1989) or overgeneralization of parallel structures (e.g., Erdogan, 2005; Selinker, 1992). Thus, it seems the failure of L2 speakers to produce this structure reflects the difficulty faced by them in producing this construction and needs to be addressed by educators.

Besides, most of the studies on structural priming are concerned with either proficient (e.g., Ameri-Golestan & Nezakat-Alhossaini, 2012; Bernolet et al., 2013) or lower-proficiency language learners (Bernolet et al., 2013; Kim & McDonough, 2008; Matsumoto & Yamashita, 2006; Schoonbaert, Hartsuiker, & Pickering, 2007) with topics like collaborative learning, question development, syntactic representations in bilinguals, and so on. It seems there is a research gap in studying the impact of priming on intermediate learners' speech production; those who are actively learning the language and are in the middle path of learning process and their abstract syntactic representations are still developing.

The most significantly, the long-term effect of structural priming as a sign of implicit learning is not completely convincing yet. Contrary to the studies (Branigan & Messenger, 2016; Corney & Mendez, 2015; Dell & Chang, 2014; Kaschak, Kutta, & Jones, 2011) which displayed long lasting effect of structural priming as a form of implicit learning, there are ample other evidence which showed that priming had no effect on language learning and use (see Bernolet et al., (2016) for evidence that structural priming is not always so long-lasting). It seems the results have been mixed, limited, and somewhat controversial in this respect.

Taken together, the focus of this study was to prime intermediate Iranian EFL participants to use an RC structure and explore whether they could produce the primed sentence compared to its parallel structure, the adjectival modifications of nouns (AN), during picture description tasks. Thus, the following research questions were addressed:

RQ1. *Does priming have any significant effect on EFL leaners' short-time production of relative clause structure?*

RQ2. *Does priming have any significant effect on EFL leaners' long-time production of relative clause structure?*

METHOD

The current study utilized a mixed-methods sequential explanatory research design to answer the research questions. The overall design of the research comprised a pre-test, a treatment phase, an immediate post-test, and a delayed post-test that was administered one week later. At the end of the study, participants responded to some oral questions in the form of semi-structured interview about their familiarity with RC structure and why they did

not produce the structure in the immediate and delayed posttests. All the data were gathered through grammatical judgment test and picture description task, the details of which are described in the following sections.

Design and Context of the Study

The study was conducted in an EFL context. Participants were divided into two groups. The first group (G1) received priming as their treatment. The second (G2) group was served as the control one. Except for the treatment phase, the other phases of the study: the pre-test, the immediate post-test, and the delayed post-test, were the same for all participants.

It is worth mentioning why the design of the study used immediate- and delayed- post-tests methodology. The immediate post-test was to measure short-term effects of priming. The scores on the immediate post-test, based on lexicalist residual activation theory, are just residual activation of nodes and were not considered as learning. The delayed post-test scores (implemented one week later) show the long-lasting effect of structural priming, based on implicit learning account. Therefore, if the delayed post-test scores displayed the long-lasting effect of priming, the researcher would attribute it as a manifestation of implicit learning (e.g., Branigan and Messenger, 2016; Dell and Chang, 2014; Shin and Christianson, 2012). In other words, if the implicit learning account presupposes that we store abstract structural representations of structural priming for long lags (Tooly & Traxler, 2010), it raises the possibility that the absence of priming in long lags (scores on the post-test sessions) suggests the absence of learning. In fact, implicit learning was operationalized in this study as the enduring effects of priming after a week as measured through the delayed post-test.

Participants

The participants of the study comprised 40 intermediate female EFL learners, with an average age of 18-25 years old. They were selected through clustering sampling from a pool of 70 language learners in different institutes of Isfahan. To make them homogeneous, Oxford Quick Placement Test (UCLES, 2001) was administered. Besides, a grammatical judgment test (GJT) was administered to measure their linguistic knowledge about RCs. They were then divided into the experimental and control groups, 20 in each group.

All the participants were late learners who had not learnt Persian and English simultaneously. None of the participants reported knowledge of any L2 other than English. They had attended English institutes twice a week to receive some hours of instruction in English. They were under communicative language teaching. None of them were aware of the purpose of the experiment. For participants' data to be included in the analyses, they had to meet the criterion of being present for all tasks on all days (i.e., pre-test, treatment, immediate, and delayed post-test).

Instruments

Three instruments were applied in the current study, which are explained below:

The first instrument was a selection of some pictures for the picture description task. All of the pictures consisted of filler pictures, prime pictures, and target pictures. The function of filler pictures was to conceal the purpose of the study by providing unrelated structures and the sentences that were elicited through target pictures were actually the data of the study. Using a Google image search, 118 freely available pictures from the Internet were sourced and used as the primary materials. Of these, seven pictures were used as practice items: three in the pre-test and four for priming. 47 pictures were for general use as fillers and 12 pictures were used as prime pictures for the treatment. Finally, 52 pictures were applied to elicit target structures during pre-test, treatment, immediate, and delayed post-test. In order to check the reliability of picture description task, a pilot study was done. Face and construct validity of the test was also checked by three experts in the field.

The second instrument was a grammatical judgment test. The justification behind the use of GJT was that the effectiveness of priming

depends on the existence of linguistic competence of the given structures in the participants' minds (Kan and Chun, 2017; McDonough and Fulga, 2015). The grammar test was piloted before being employed in the present study (The number of participants who took part in the pilot study was 30. These participants were different from those participating in the main body of the experiment). The maximum number of items in GJT was 50, out of which 12 of them tried to measure participants' knowledge about RCs. The reliability of GJT was checked through computing Cronbach's Alpha and showed the reliability of α= .78. Test-takers were required to indicate/mark whether each sentence was grammatical or ungrammatical.

Finally, an Oxford Quick Placement Test (UCLES, 2001) was administered to measure participants' level of proficiency and ensures their homogeneity as intermediate language learners. The paper and pencil version of this test was applied. It took relatively 30 minutes to be completed by language learners. The test included three subsections that each section contained items related to grammatical structures, vocabulary, and reading comprehension. Items were in the multiple-choice format and the maximum possible score that could be gained by participants was 40. This test is widely used by both second and foreign language researchers as a placement test (Berthold, 2011). Although the test has gone under Cambridge ESOL quality control procedures (Geranpaye, 2003), its reliability for the present study was assessed through the Cronbach's Alpha test and it came to (α= .79).

Data Collection Procedures

Data collection was carried out independent of participants' class hours. They were asked to assign a time for participation in the experiment. However, they were not told that they were taking part in an experiment, so they were not aware of the nature of the study; instead, they were informed that the institute was interested in how well they could make use of their English proficiency in some tasks. The researcher was not their language teacher.

Initially, the grammatical judgment and language proficiency tests were administered. As to the experiment, the experiment was individually conducted in a quiet classroom of the language institutes in front of a laptop using the Microsoft Power Point Program. Data collection was carried out under the supervision of the researcher. However, participants did not know that the other person in front of the laptop is the researcher. All the prime, filler, and target sentences were presented visually. The participants' speech was recorded on a high-quality voice recorder for orthographic transcription on a separate device. They were informed about the experiment and their voice recording after the experiment. The experiment was self-paced. Therefore, the time of the data collection procedure varied slightly between each individual.

The study was undertaken over three consecutive weeks with the pre-test in the first week, treatment and immediate post-test in the following week, and the delayed post-test in the third week (see Bernolet et al., 2013; Kaschak et al., 2011 for a similar procedure).

In the pre-test session, participants performed the picture description task for approximately 10 minutes. Prior to task completion, a brief instruction regarding how they were required to do with pictures was provided by the researcher. During this phase, some pictures were presented to participants and they were asked to describe them with the first structure that came into their mind (because of the sentence starters, each picture could be described as either an AN or an RC structure). No prime was presented to them during this phase.

In the treatment sessions, participants experienced 12 trials (see Figure 1 as an example of a trial). Each trial was started with a filler sentence, which was written in black and they had to read it. Then, they were instructed to press the arrow key to move to the next picture in which they saw the prime picture and a red sentence beneath it, which they had to read and repeat it (see Hartsuiker & Westenberg, 2000). In the sentences that appear below, prime pictures contain RC structure and implicitly activate the participants' linguistic node about

RCs. Repetition task triggered structural priming (Konopka & Bock, 2009), and increase activation of target syntactic representations (G´amez & Vasilyeva, 2015; Kim & McDonough, 2016). After the priming, some more filler sentences appeared on the screen. The function of filler sentences was to reduce the effect of explicit memory. That is, if prime and target sentences appeared immediately one after the other, the production of RC could be attributed to explicit memory. By the use of filler sentences, the impact of explicit memory decreased and the production of RC after a short delay between prime pictures and target pictures could not be attributed to memory factors.

Finally, the target pictures were presented to them with some incomplete sentences below them in black that needed to be described and completed as quickly as possible by one of the two alternate structures (RC or AN structure). In fact, AN structure might be used as a parallel format of RC as a simpler structure (Leonard, 2010). In addition, the justification behind the use of sentence starters ("*we saw*" in Figure 1 above) was to decrease the variability in participants' production (e.g., Conroy and Méndez, 2015; McDonough and Trofimovich, 2009). Without the use of sentence starters, participants started to create random sentences, most of which were unrelated to the study, impacting on the practicality of much of the data. The existence of sentence starter could increase the ease of sentence production burden for the participants as well. Besides, an adjective was presented below the target pictures. Participants were instructed that they had to use the adjective in their description. For example, a picture with an incomplete sentence like "*our store is located ...*", and with the adjective *busy* could be described in either form of "*our store is located on a street which is very busy*" or "*our store is located on a very busy street*".

The control group also saw all of the test target pictures, but these were not preceded by any of the test prime sentences or pictures. Instead, each target picture was preceded by one of the filler sentences/pictures from the priming set. In other words, the control group saw all of the target pictures, but these were not preceded by any of the experimental prime sentences or pictures.

Immediate post-test was taken in the final session of the treatment. After a week, the delayed post-test was implemented and it took ten minutes. Like pre-test session, pictures displayed in the post-tests were used to elicit the structures that were not preceded by any prime pictures. Some filler pictures were also presented in the post-tests.

Finally, at the end of the experiment, participants answered some questions orally in the form of a brief semi-structured interview. Researchers were interested to know if they have learnt RC structure previously, if they have any difficulties comprehending and processing RC structure, if they think they have sufficient mastery in producing RC structure, if they often produce it in their spontaneous language use, why did or didn't produce the RC structure during the picture description task.

Data Analysis Procedure
In order to analyze the data, participants' voices (produced during the pre-test, and the immediate and delayed post-tests) were transcribed. Then, scoring procedure was conducted. Each sentence with RC structure was scored as 'target=1', AN-structure as 'alternate=0', and all other responses (incomplete utterances and sentences that did not strictly incorporate the sentence starter) were coded as 'other=0'. Besides, errors related to articles, tense and agreement in participants' production were ignored. There were three raters who were PhD holders of Teaching English as a Foreign Language (TEFL) and the maximum scoring was 12 since there were only twelve pictures that needed to be described by the participants. Inter-rater reliability was calculated as .94.

The items of the grammatical judgment test were scored as 'correct' or 'incorrect', measuring the accuracy of each response. Out of the 50 test items that were included in the grammatical judgment test, just the scores of the 12 test items that directly measured the knowledge of RCs were included in data analysis. As such, the maximum possible score

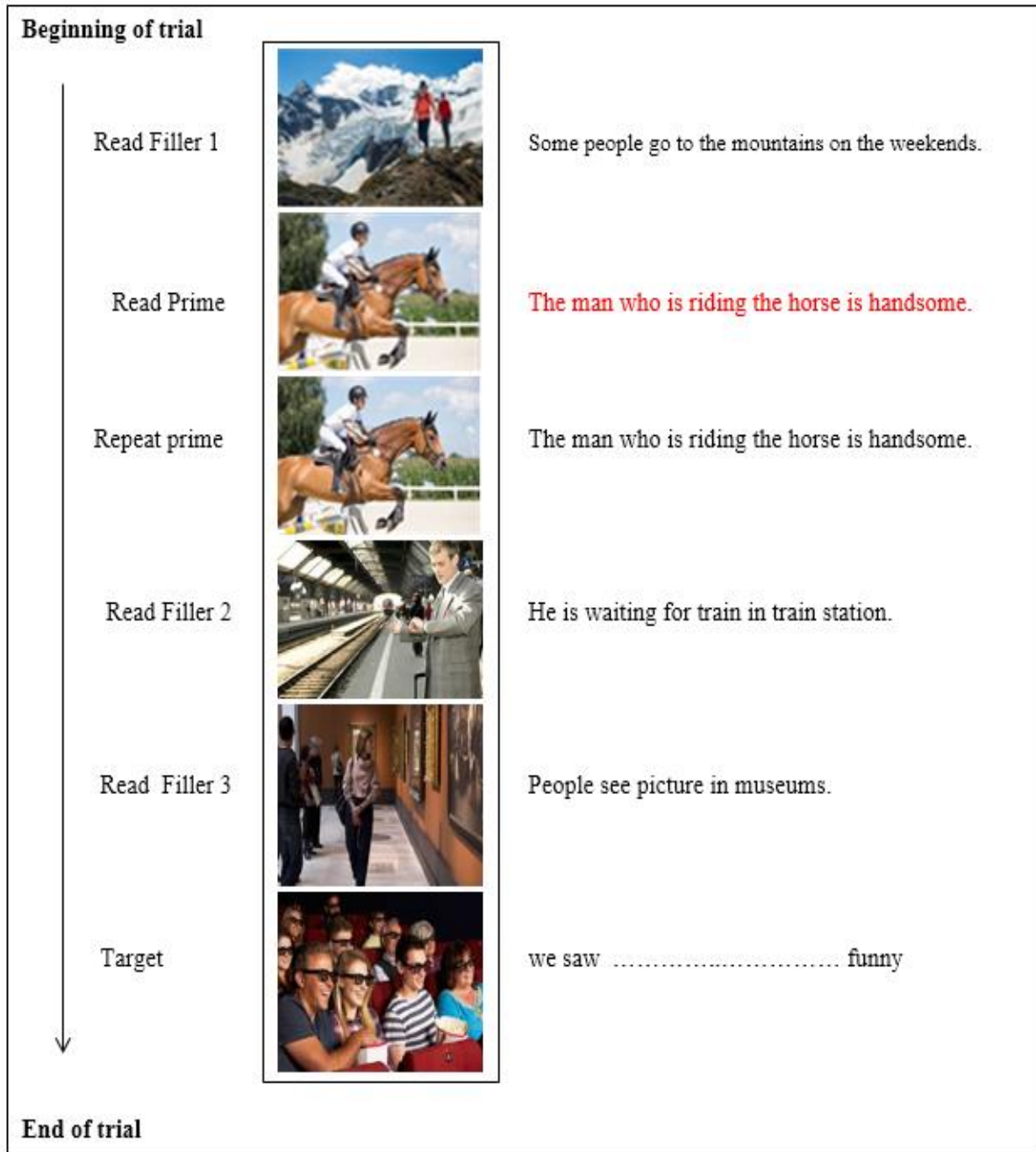was 12 for this test as well. The reliability measure of the test after piloting was calculated as .84.

Beginning of trial

Read Filler 1		Some people go to the mountains on the weekends.
Read Prime		The man who is riding the horse is handsome.
Repeat prime		The man who is riding the horse is handsome.
Read Filler 2		He is waiting for train in train station.
Read Filler 3		People see picture in museums.
Target		we saw .... funny

End of trial

Figure 1. An example of a trial in the priming intervention

In order to analyze the effect of priming on EFL learners' production of RC structure, descriptive and inferential measures were conducted. Descriptive statistics was applied for the learners' responses to the grammatical judgment test on the one hand, and the development of mean scores after the treatment on the other hand. As to inferential measures, one-way analysis of variance (one-way ANOVA) was conducted to investigate EFL learners' production of RC structure after the intervention and a week later to compare the scores for the experimental group's performance. Finally, the immediate and delayed post-tests of the experimental and

control groups were inferentially compared using independent samples t-test.

RESULTS

The results of the study included three sections of 1) EFL learners' linguistic knowledge of RC structure; 2) EFL learners' production of RC structure in the experimental group; and 3) EFL learners' production of RC structures in the experimental and control groups. Each is taken into account below:

EFL Learners' Linguistic knowledge of RC Structure

The learners' responses to grammatical judgment test were taken into consideration since the effectiveness of priming depends on the existence of linguistic competence of the given structures in the participants' minds. Table 2 shows descriptive statistics for EFL learners' results of grammatical judgment test.

Table 2

Descriptive Statistics for EFL Learners' Scores of Grammatical Judgment Test

	N	Min	Max	Mean	SD	SEM
Grammatical judgment test						
Priming group	20	7	12	8.90	2.75	.50
Control group	20	6	11	8.40	2.44	.49

The mean values demonstrate that participants in both experimental and control groups possessed an acceptable level of RC structure (more than the average of 6 out of 12) in their linguistic representations as a pre-requisite for structural priming to take place.

EFL Learners' Production of RC Structure in the Experimental Group

The experimental group's scores for the pre-, immediate, and delayed post-tests were analyzed descriptively as shown in Table 3.

Table 3

Descriptive Statistics for the Experimental Group's Production of RC structure in Short- and Long-Term

N	Mean	Std. Deviation	Std. Error	Minimum	Maximum	N
Pretest	20	1.35	0.813	0.182	0	3
Immediate	20	1.80	0.834	0.186	0	3
Delayed	20	1.65	0.875	0.196	0	3

The first research questions sought to investigate if priming has any significant effect on experimental group's production of RC structure in short-term. Table 3 shows that there existed a negligible improvement form the pre-test [$M = 1.35$; $SD = .81$] to the immediate post-test [$M = 1.80$; $SD = .83$]. As to the second research question, which sough if priming has any significant effect on experimental groups' production of RC structure in long-term, descriptive results in Table 3 demonstrate that there was a small increase from the pre-test to the delayed post-test [$M = 1.65$; $SD = .87$].

Besides, the learners' production of RC structure decreased from the immediate post-test to the delayed post-test descriptively. To inferentially compare the mean scores of the experimental group in short- and long-term, one-way ANOVA was conducted prior to which the homogeneity of variances had to be checked as in Table 4.

As to Table 4, *sig.* value is more than .05, which verifies the homogeneity of variances in the experimental group. Table 5 below indicates the results of one-way ANOVA for the experimental group.

Table 4

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
0.225	2	57	0.800

Table 5

One-Way ANOVA for the Experimental Group's Production of RC Structure in Short- and Long-Term

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.100	2	1.050	1.485	0.235
Within Groups	40.300	57	0.707		
Total	42.400	59			

Table 5 shows no insignificant improvement for the EFL learners' production of RC structure in short- and long-term [F (2,57) = 1.48; *p* = .23>.05]. In other words, priming did not have any significant effect on the production of RC structure in short- and long-term by EFL leaners.

EFL Learners' Production of RC Structures in the Experimental and Control groups

EFL learners' production of RC structure in the experimental and control groups was investigated both descriptively and inferentially. Table 6 indicates descriptive data for the two groups' production of RC structure.

Table 6

Descriptive Statistics for the Experimental and Control Groups' Production of RC structure in Short- and Long-Term

		N	Mean	Std. Deviation	Std. Error	Min	Max
	Pretest	20	1.35	0.813	0.182	0	3
Priming	Immediate	20	1.80	0.834	0.186	0	3
	Delayed	20	1.65	0.875	0.196	0	3
	Pretest	20	1.20	1.056	0.236	0	3
Control	Immediate	20	1.35	0.933	0.209	0	3
	Delayed	20	1.25	1.020	0.228	0	3

As to Table 6, descriptive statistics reveal that very small and negligible differences between the pre-tests [*M* = 1.35; *SD* = .81, *M* = 1.20; *SD* = 1.05], immediate post-tests [*M* = 1.80; *SD* =.83, *M* = 1.35; *SD* = .93], and delayed post-tests [*M* = 1.65; *SD* = .87, *M* = 1.25; *SD* = 1.02] of the experimental and control groups

were observed, respectively. Independent samples t-test was conducted in Tables 7 to inferentially compare the two group's RC production for the pre-test, immediate, and delayed post-tests.

Table 7

Independent Samples T-Test for the Experimental and Control Groups' Production of RC Structure in Short- and Long-Term

	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
				Lower	Upper
Pretest	0.618	0.150	0.298	-0.453	0.753
Immediate	0.116	0.450	0.280	-0.116	1.016
Delayed	0.191	0.400	0.300	-0.208	1.008

As table 7 demonstrates, the mean difference between the immediate post-test scores of the two groups were not significant [*p* = .11>.05], which shows that the experimental group did not significantly outperform the control group after being exposed to priming intervention.

Finally, inferential analysis in Table 7 reveals that there was not any significant difference]*p* = .19>.05] between the delayed post-tests of the experimental and control groups regarding the production of RC structures.

In sum, through quantitative analysis of the research questions, it was revealed that EFL language learners possessed the linguistic competence of RC structure prior to the treatment. However, priming did not have any significant effect on EFL learners' production of RC structure in the immediate and delayed post-tests. Finally, there was not any significant difference between the experimental and control groups' production of RC structure affected by priming and non-priming in the immediate and delayed post-tests.

DISCUSSION

The current study sought to investigate the effectiveness of priming on EFL learners' RC production by means of picture description task. A grammatical judgment test was taken at the beginning of the study since the effectiveness of priming depends on the existence of linguistic competence of the given structures in the participants' minds. Then the main body of data was gathered through a picture description task.

With regard to the first research question, the results revealed a slight improvement form the pre-test to the immediate post-test in learners' performance although there was no significant improvement regarding the participants' production of RC structure. Comparing and contrasting the results of this study with previous research on priming effect, the negligible rise of relative clause production immediately after treatment is attributable to the impact of explicit memory on subsequent production and cannot be regarded as a form of learning as discussed by residual activation

theory (Pickering and Branigan, 1998). Based on this theory, immediately after priming intervention, RC structure remains active temporarily as the consequence of the exposure with preceding RC pictures that participants encountered during intervention, which this temporary and small arousal leads to the repetition and retrieval of the same structure in the immediate post-test. For example, Bernolet et al.'s study (2016) showed that participants' memory was more significantly active in immediate condition compared to the time when there was an interruption between the target and prime sentences. The focus of their study was on three different constructions namely transitive, dative, and two different auxiliary-verb word orders in Dutch. For all the three constructions, priming effect was significant in immediate condition. Similarly, the results of Hartsuiker et al.'s study (2008) revealed that structural priming effect is more significantly observable in immediate condition especially when the prime and target sentences share similar lexical items.

With regard to the second research question considering the impact of priming on participants' production in long-term, the findings showed that their production was not subject to significant improvement in delayed post-test. This Finding is in alignment with research study conducted by Wheeldon and Smith (2003) in which they investigated priming effect through a sentence completion task and found no persistence in priming effect when there was intervention between trials. Similarly, the analysis of the priming corpora (Gries, 2005; Reitter, 2008; Szmrecsanyi, 2005) revealed that although priming effect might last for long period of time for example after a day (shin and Christianson, 2012) or a week (Corney and Mendez, 2015), the effect displays a steep reduction after the few seconds of facing prime sentences. Shin and Christianson (2012) argue that when the power or the influence of explicit memory clears off, the priming effect drastically falls in longer-term as well. However, contrary to these findings, there is a large body of studies (Dell and Chang, 2014; Kaschak et al., 2014; Shin and Christianson, 2012; McDonough and

Chaikitmongkol, 2010) which showed that there was a considerable improvement in learners' production after priming intervention. Based on the findings of these studies, structural priming has been influential to tune learners' production for some of the structures in specific contexts. For example, in a study conducted by Kaschak et al. (2011), participants were biased toward producing a direct object construction. The results showed that the priming effect lasted for a week and participants were able to transfer this to the second phase of the study. Similarly, Kaschak et al. (2014) designed a set of studies (six experiments) to explore the persistence of cumulative priming when task modalities changed between different phases of the study. Their results showed long-lasting cumulative priming effects over the course of a week. Kaan and Chun (2017) also assessed the similarity of priming mechanisms between native and L2 speakers. Both groups of speakers exhibited priming effect over a course of week.

However, with regard to the findings of the present study, it seems priming manipulation was not strong enough to improve RC production. This might be explainable through RC complexity. After the experiment, during the oral interview, in response to the questions which asked about participants' mastery in comprehension and production of RC structure, 75% of participant asserted that they were completely familiar with this structure and had no difficulty in comprehending it. However, with regard to production many of them claimed that the production of AN structure was simpler for them probably because the length of this structure is more than adjectival constructions, it puts too much cognitive burden on them to produce this structure. This reminds us of what Chomsky (1993) called the economy of derivation in which he claims that some processes are cheaper or preferred over the others. Relative clauses belong to the syntactic category labeled as CP (Complementizer Phrase) and are embedded in a complex nominal expression, DP (Determiner Phrase), while adjectives are embedded in NP (Noun Phrase) and modify the whole construction that they govern. It seems the

difference in the structural type of these two structures lead to cognitive complexity and it has an influence on the priming effect. This finding is in line with the findings in the literature which showed that there is an interaction between priming effect and the structural complexity. For example, the study by Shin and Christianson (2012) compared the learning of double object dative with phrasal verb through the priming paradigm. Their findings showed that because double object datives have multiple thematic arguments, it is considered as a complex structure and this explains why the priming paradigm was not influential on this structure compared to phrasal verb construction, which has just two components. Similarly, Kutta et al. (2017) showed that the priming effect was more dominant with PO than DO construction because the former always contains a preposition 'to' and it is more marked than DO construction.

Besides, in line with swain's claim (1992) that the adjectival modification of noun is one of the simple, useful, and frequent structures that is taught to EFL and ESL learners within the elementary, basic levels of language acquisition process, participants affirmed that AN-structure is a simple and frequent construction that well-embedded in their linguistic representation compared to RC structure. Participants came to the belief that the first structures taught to them are the simplest and more useful ones and the latter ones are mainly complex constructions that can be employed in speech production just for language variability. They believed that when there is a possibility to express a concept with a simpler, shorter, and more frequent concept that they have experienced in different contexts, there is no need to make an explicit attention to produce a complex structure. It might be due to what Anderson (1984) called 'one form one meaning' strategy by which language learners adopt one form to meet their language needs. These are in agreement with the claim that priming may be most beneficial and have better learning outcomes when there is a balance in learners' preference (Hartsuiker and Westenberg, 2000). It seems the good mastery

level of participants for AN- structures and their average mastery on RC- structure as the scores of their GJT showed, these two structures were not completely parallel with respect to knowledge and use and it might cause priming as an implicit technique could not manipulate learners' production for a complex structure like RC. It seems what is linguistically parallel for linguists like active vs. passive or AN- vs. RC is not psychologically and cognitively parallel for language learners in use.

The other main reason of insignificant improvement in learners' production might be the learners' proficiency level and their current state of knowledge that both of them are closely inter-related to one another and to what discussed above. The question of proficiency is a very important one since it can help determine whether priming can only take place if the syntactic procedures/structures are already relatively well established in the speaker's repertoire, or whether it can be found for structures that have not been encountered before. In this regard, the overall picture emerging from the different experiments (e.g., Ameri, 2012) seems to suggest that learners' proficiency level affects the production rate of the target structure. For example, the results of Ameri and Alnezakkati's study (2012) which was gathered through picture description task on the acquisition of indirect speech by Iranian EFL learners showed that learners with higher proficiency in the second language showed an increased rate of target production while learners with lower proficiency level did not show any improvement with regard to their production. Besides, in their study, Kim and McDonough (2008) investigated the role of proficiency level on production of passives among Korean EFL learners. They divided their 76 participants into three proficiency groups, namely, high, mid, and low. Their results showed that the magnitude of priming was greater for the low group than for the middle and high groups. The findings of these studies show priming has been beneficial for lower proficiency groups which have less experience with a structure (Nitschke et al., 2014) and their mental representation is weak, thus it is more

susceptible to change (Chang et al., 2006; Jaegerand Snider, 2013).

Based on Bernolet and Hartsuiker's (2017) claims, in the earliest stages of learning, L2 speakers' linguistic representations are lexically oriented without specific abstract syntactic depth. At this stage, L2 speakers may rely on existing L1 structures or imitate recently heard L2 structures when producing L2 utterances. Therefore, the possibility of repeating the prime sentences in subsequent production increases in the lower proficiency level. However, as proficiency increases, the syntactic representations strengthen for most of L2 structures. When language learners have less linguistic experience with structures, their linguistic processing is less "precise" and more prone to "change" (Chang et al., 2006), leading to larger priming effect. The intermediate proficiency level of participants seemed acted as an intermediary intervening variable.

Taken together with the current results, these findings highlight the complex nature of implicit learning from auditory input, even in situations where speakers have previous knowledge of the given structures. This is consistent with prior research (e.g., McDonough and Fulga, 2015) which showed that the brief exposure to priming as an implicit teaching technique is not sufficient for observing a substantial improvement in learners' schemata. Thus, it seems the implementation of a purely priming paradigm as an implicit form of learning is not adequate and adding other techniques like explicit instruction and more repeated exposure might increase its practicality.

CONCLUSION

The current study investigated the effects of priming paradigm as an implicit form instruction on Iranian EFL learners' RC production. The results of descriptive and inferential measures demonstrated that this paradigm on its own could not have any significant impact on the learners' speech production. Although the results of this experiment showed that the brief experience of the priming for the RC structure was not sufficient for Iranian language learners, this

does not mean that this kind of input has limited potential in terms of promoting L2 learning and language use. Rather, it implies that further steps may need to be taken to increase its facilitative role in language production and learning. Although most previous studies have oriented around cognitive and linguistic mechanism in L2 acquisition, priming can be employed in certain challenging but interesting area of research that tries to investigate how learners extract, internalize, and subsequently produce various aspects of language. Since structural priming is independent of phonological, pragmatic, and semantic information in input, it is vulnerable to be employed as an implicit teaching technique. Priming paradigm can be employed in interactional and communicative activities in which L2 learners can improve their competence via interaction with more advanced language learners who prime lower-level learners to create more advanced form. In this context, an instructor might design priming activities with just a focus on troublesome construction to accelerate and boost priming effect.

As to the limitations of the study, RC and Structures were merely focused. If two other alternative structures were added to the present ones, the effect of structural complexity on priming effect that was discussed in the discussion part became more evident. Thus, it should be kept in mind that these conclusions are only applicable to the RC construction and the intermediate level Iranian EFL learners. The data of the study were gathered individually out of the classroom setting, demanding further research to be carried out in the natural classroom-based setting since natural conversation does not occur in isolated sentences, rather in connected discourse, and context- dependent setting. As such further research needs to be carried out to investigate the role of discourse context on long-term priming. In addition, the role of individual differences and their openness to linguistic variability should have been considered more thoroughly. The investigation with other languages and linguistic structures together with individual learner variables would expand

the scope of the L2 priming and increase the generalizability finding to broader population. Last but not least, this study was limited to one treatment for priming while further research needs to be implemented to examine what crucial activities or procedures can be added to priming, such as cumulative priming to boost its effectiveness. One possible suggestion is to explore the difference between the times when explicit methodologies are mixed with priming compared with non-implementation.

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