On the Impact of Mode of Presentation and Age on Parsing Structurally Ambiguous Relative Clauses

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Abstract. The relative clause attachment preferences of female Persian learners of English were investigated regarding their age and modes of presentation (online/offline and holistic/segmented). 50 female native speakers of Persian ranging in age from 15 to 25 participated in the study. The instruments used in the present research included two tests of ambiguous sentences: 1) a grammaticality judgment test, and 2) the main test which was presented in three separate forms: a) offline, b) online complete presentation (timed) and c) online segment by segment sentence (self-paced). This study used the method employed by Kim and Christianson (2013) for determining the attachment preferences of the participants. The results revealed that the participants' age affected the attachment preferences significantly in that adolescents had a clear determiner phrase 1 preference. There was also a statistically significant difference among the three modes of presenting the materials. The findings revealed that learners transferred their attachment strategies from their mother tongue to English, which provided support for transfer hypothesis. The research findings on whether L2 learners can achieve native like patterns of ambiguity resolution is still less than conclusive and findings seem to suggest that L2 learners apply parsing strategies which are less automatized than native speakers and even at odds with some studies reporting no transfer of L1 parsing strategies. Language teachers should make their learners cognizant of relative clause attachment preferences in English to avert their transfer of their mother tongue strategies in determining the antecedents of the relative clauses.

Keywords: age, attachment preferences, offline presentation, online presentation, Persian.

Саркгош Мегді, Ґаед Рахмат Мегді. Про вплив віку та способу подання на аналіз структурно неоднозначних означальних підрядних речень.

Анотація. У статті досліджено переваги студенток-носіїв перської мови, які вивчають англійську мову, щодо приєднання підрядних означальних речень з урахуванням вікових особливостей та способу подання матеріалу (онлайн/офлайн та цілісний/сегментований). У дослідженні взяло участь 50 жінок-носіїв перської мови віком від 15 до 25 років. Інструменти включали два тести неоднозначних речень: 1) тест на граматичну правильність і 2) основний тест, який був представлений у трьох окремих формах: а) офлайн, б) повна презентація онлайн (із заданим часом) і в) посегментне відтворення речення онлайн (у власному темпі). У цьому дослідженні було використано метод Kim і Christianson (2013) для визначення переваг респонденток у способах приєднання. Результати показали, що вік учасниць суттєво вплинув на їхній вибір, оскільки юнки мали чітко виражену перевагу у виборі фрази 1. Також було виявлено статистично значущу різницю між трьома способами представлення матеріалу. Дані показали, що студентки перенесли свої стратегії приєднання з рідної мови на

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англійську, що підтвердило гіпотезу про ефект наслідування. Результати досліджень щодо того, чи можуть студенти, які вивчають мову L2, досягти моделей вирішення неоднозначності, подібних до рідної мови, все ще не є остаточними. Отримані дані свідчать про те, що студенти, які вивчають мову L2, застосовують менш автоматизовані стратегії синтаксичного аналізу, ніж носії мови, і навіть суперечать деяким дослідженням, в яких повідомляють про відсутність перенесення стратегій синтаксичного аналізу, які використовують у рідній мові L1. Викладачам іноземних мов слід ознайомити своїх студентів з перевагами щодо приєднання підрядних означальних речень в англійській мові, щоб запобігти перенесенню студентами стратегій їхньої рідної мови при визначенні антецедентів у підрядних означальних реченнях.

Ключові слова: *вік, переваги у приєднанні, офлайн подання, онлайн подання, перська мова, англійська мова.*

Introduction

Ambiguous sentences usually have more than one interpretation. One type is structural ambiguity an example of which is *someone shot the servant of the actress who was on the balcony.* There are two determiner phrases (DPs): *the servant* (DP1) and *the actress* (DP2)*,* followed by a relative clause (RC): *who was on the balcony, which* can modify either *the servant* or *the actress.* Previous psycholinguistic research on such ambiguous sentences has investigated the preferences of native speakers in attaching RC to either DP1 or DP2 in such genitive constructions.

Earlier studies have reported contradictory results. For example, some studies showed that adult native speakers of English preferred to associate the RC with the second DP (Dussias, 2003; Gilboy et al., 1995; Hemforth et al., 2015). A preference for DP1 attachment was also reported for similar genitive constructions in Spanish (Cuetos & Mitchell, 1988). Research findings have confirmed that even the speakers of a single language show variations in their preferences (see, e.g., Dussias, 2003; Fernandez, 1999; Papadopoulou & Clahsen, 2005). A vast majority of studies, however, have explored attachment preferences among English native speakers (e.g., Cuetos & Mitchell, 1988; Dussias, 2003; Fernandez, 2003; Gilboy et al.*,* 1995), and non-English languages (see, e.g., Bidaoui, Foote, & Abunasser, 2016 for attachment preferences in L2 learners of Arabic; Arabmofrad & Marefat, 2008 for RC ambiguity resolution in Persian; Karimi, Samadi, & Babaii, 2021 for the effect of semantic priming on the resolution of ambiguous RCs among Persian learners of English).

The present study focuses on female Persian-speaking English learners who acquired their second language (L2) after puberty. In the previous studies in the Persian context, gender was rarely controlled for and we decided to control gender variable in the present study. Hence, this study zeroed in on female learners of English and their attachment preferences to resolve the conflicts due to the gender factor. In other words, different genders may have different attachment preferences and by focusing on female learners, more conclusive results can be acquired. Besides, a replication study is warranted in the future research on male learners to compare the results and determine if both genders exhibit similar preferences.

The present study investigated RC attachment preferences among female Persian learners of English with regard to two factors: a) age, and b) RC presentation modes. The study investigated whether the age of the learners (adolescents vs. adults) and different modes of presenting the material (i.e., offline vs. online and segmentation vs. holistic) might differently affect the female learners' attachment preferences. Previous research (Arabmofrad & Marefat, 2008; Fernández, 1999) revealed that L2 learners of English produced more high-attachment (DP1) answers than the native speakers. Therefore, this study targeted the interface of RC presentation modes with the age factor and its influence on the attachment preferences among Persian English learners.

Speakers of some languages like Spanish prefer to attach the RC to DP1, while there are speakers of other languages like English, who prefer DP2 attachment. There are still languages like Japanese (Hawkins, 1999) whose speakers do not show any preference for either DP1 or DP2 attachment. A number of studies have examined attachment preferences among L2 learners (see, for example, Bidaoui et al., 2016; Karimi et al., 2021; Marefat & Farzizade, 2018; Marefat & Samadi, 2015; Papadopoulou & Clahsen, 2003). Papadopoulou and Clahsen (2003), for example, investigated RC attachment preferences among three different groups of Greek learners and native speakers. They found that with preposition phrase antecedents, the learners showed similar preferences to the native speakers of Greek, which is low attachment. However, with genitive antecedents, no clear preferences were observed among the learners. The findings disclosed that L2 learners processed ambiguous sentences neither like their L1 nor like Greek native speakers. The authors concluded that the L2 learners tended to rely more "on lexical cues than the native speakers and less on purely structurally-based parsing strategies" (Papadopoulou & Clahsen, 2003, p.502). Bidaoui et al. (2016) investigated RC attachment preferences among Arabic speakers and the L2 learners of Arabic. In the offline task, both native speakers and the learners preferred high attachment, but only the L2 learners of Arabic favored high attachment in the online task. Their findings supported the structurally-based explanations of RC attachment preferences and presented an argument against the claim that L2 learners use non-native-like parsing principles in sentence processing.

In the Persian context and among Persian learners, Arabmofrad and Marefat (2008) aimed to discover how Persian native speakers dealt with RC attachment ambiguities in sentences containing a complex NP followed by RC. They used an online technique to identify the nature of this process. The results revealed that high attachment was the strategy utilized by Persian native speakers for this type of ambiguity. In another study on the Persian learners of English by Karimi et al. (2021), the effect of semantic priming on RC ambiguity resolution was examined. They found that semantic priming impacted the participants' attachment preferences. Their findings were compatible with the Constraint-Based Models of sentence processing, which claim that multiple sources of information, including semantics, are utilized in sentence processing. Marefat and Samadi (2015) attempted to investigate if parsing ambiguous RCs was affected by semantic priming among the Persian learners of English with different proficiencies and working memory loads.

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They reported that semantic priming did not influence the antecedent choice but syntactic information did.

In a more recent study in the Persian context, Marefat and Farzizade (2018) attempted to find out if the Persian learners of English could switch to optimal processing strategies and whether working memory capacity contributed to this. They found that the learners utilized the strategies applied by English native speakers, which demonstrated target language-like processing of RCs and the attrition of L1-like parsing processes. Their findings corroborated "skill-through-experience" model adopted by the researchers, who criticized the role of working memory capacity in the parsing of L2. However, high-capacity L2ers' preferences in L1 had attrited (becoming English-like), and low-capacity ones had no preference. They reported that L2 learners did not differentiate between L1 and L2 parsing in RCs.

As the above review makes manifest, no study has examined the effect of age on RC attachment preferences among Persian learners. Nor has any researcher investigated if online vs. offline and segmented vs. holistic presentation of RCs impacts the attachment preferences among Persians. Therefore, in light of the previous findings, the present research answers the following questions.

RQ1: Does age have any significant effect on the attachment preferences of female Persian learners of English?

RQ2: Does online/offline presentation of RCs have any significant effect on the attachment preferences of female Persian learners of English?

RQ3: Does segmented/holistic presentation of RCs have any significant effect on the attachment preferences of female Persian learners of English?

Method

Participants

Fifty female native speakers of Persian, who studied in a private language school, participated in this study. Their age ranged from 15 to 25 (Mean = 19; SD =3.7). Some were high school students and others graduated from different universities. A general proficiency test, namely the Quick Oxford Placemen test, was used to homogenize the participants. The participants were unaware of the purpose of the study. The participants were divided into two groups according to their age, namely, adolescents (n=23) and adults (n=27). In fact, those below 18 were classified as adolescents and those above 18 were categorized as adults. In the present study, we intended to investigate the impact of age on RC attachment preferences, as elucidated in the introduction.

Instruments

The instruments used in the present research included two tests of ambiguous sentences: 1) a grammaticality judgment test, and 2) the main test, which was

presented in three separate forms: a) offline, b) online complete presentation (timed), and c) online segment by segment sentence presentation (self-paced).

Grammaticality Judgment Test

A grammaticality judgment test consisting of 12 grammatical and ungrammatical sentences was used. The participants were supposed to rate the sentences on a scale from 1 (the least acceptable) to 6 (the most acceptable). The test assessed the participants' familiarity with the sentence structures they used in the main experiment. Hence, any possibility that their lack of grammatical knowledge might oblige them to the selection of an option was excluded. The participants were required to rate the sentence grammaticality from 1 to 6 since due to the multiple choice format of the questions they might have answered the questions by chance. This possibility was, therefore, ruled out.

The Main Test

The main test used in this study was presented in three forms to the participants. Totally, 40 sentences including five practice sentences, 15 experimental sentences, and 20 filler sentences were used in the main phase of the study. All the experimental sentences contained both DP1 and DP2, followed by an RC that referred to both DP1 and DP2. DPs functioned as objects and RCs as subjects. The practice, experimental, and filler sentences were controlled concerning complexity and length and were created by the researchers. The practice sentences acted as a warm up and the experimental sentences were interspersed with filler sentences to prevent strategy use in selecting DPs. Practice, experimental and filler sentence were followed by two choices in order to find out which DP was preferred by the participants. Almost in half of the sentences, the first option referred to DP1, and the other choice represented DP2. Two examples are provided below:
Experimental sentence and the options:
The doctor recognized the nurse of the pupil who felt very tired.
A) The nurse felt very tired
B) The pupil felt very tired
Filler sentence and the options:
The logic explained during the lecture was quite complicated.
A) The lecture was quite complicated.
B) The logic was quite complicated.

Procedure

To address the research questions, a series of experiments on the processing abilities of the participants were designed and implemented. At first, the sentence acceptability judgment test was distributed among adolescents and adults. Each group was tested separately. The sentence acceptability judgment test consisted of 12

sentences that were supposed to be answered in 10 minutes, and the participants were asked to rate the sentences from 1 to 6. Numbers "1" and "2" were interpreted as ungrammatical, and "5" and "6" showed grammaticality. In addition, numbers "3" and "4" were interpreted as either "I don't know", or a haphazard answer. The participants were asked to select the correct number by circling or ticking their choices on the test paper. In the same session, the participants took other tests as explained below.

Procedure for Offline Test

In the main offline experiment, the participants (n=16) began with five practice sentences as a warm-up, and continued with 20 filler and 15 experimental sentences. Each sentence in the test was followed by two options about the truth value of the previous sentence. The participants were asked to select one option in their test papers. Before administering the test, the participants were ensured that there was no time limitation for answering.

Procedure for Online Complete Sentence Presentation (Timed)

The sentences were presented on a laptop screen. In this test, each sentence remained for five seconds on the screen, and sentences were presented on black and white background. One slide was allocated for each sentence from 1 to 35, and their options were presented on a separate slide. The options were piloted before the main experiment, and the decision to devote five seconds to each sentence was made based on the pilot results. The options were presented in the form of statements that showed the truth value of the sentence. The participants (n=17) were asked to answer the questions only by choosing "A" or "B," and then the test taker transferred the answers to a pre-developed answer sheet. This test was employed to determine whether presentation modes (online/offline) significantly affected the attachment preferences of L2 female Persian learners.

Procedure for Online Segment-by-Segment Sentence Presentation (Self-Paced)

In this test, the sentences were presented in segments. The participants (n= 17) were asked to read each segment carefully and move to the next segment by pressing the "Enter" key until they reached the full stop. By pressing the "Enter" key again, they were able to see the options. In this type of online test, there was no time limitation. In order to make the students familiar with the online test, they were asked to answer practice sentences as a warm-up activity. The experimental sentences were interspersed with filler sentences to rule out any possibility that the participants might guess the purpose of the study. In fact, this test intended to determine if sentence segmentation had any significant effect on the participants' attachment preferences.

Scoring System

Attachment Preference

This study used the method employed by Kim and Christianson (2013) to determine the attachment preferences of the participants. They assigned zero to DP2 and one to DP1. They added up all the ones and zeroes and divided this number by ambiguous sentences. If the number was more than .5 and close to one, the attachment preference was considered DP1 and if the number was less than .5 and close to zero, the attachment preference was considered DP2. For example, if one participant selected 13 DP1s and 2 DP2s for 15 ambiguous sentences, the formula to determine the attachment preference would be: $(13 \times 1) + (2 \times 0) = 13{:}15 = .86$

Results

The Effect of Age on Attachment Preferences

The first research question was "Does age have any significant effect on the attachment preferences of female Persian learners of English? According to Table 1, the mean score of the adults (.33) is less than that of the adolescents (.54). To find out the significance of the existing difference, *an independent samples t-test* was administered. The results are presented in Table 2.

Table 1
Descriptive Statistics for Attachment Preference Scores in Adults (n=27) and Adolescents (n=23)

	Participants' age	Mean (SD)
Attachment preference scores	Adults (15-18 years old)	.34 (.16)
	Adolescents (19-25 years old)	.54 (.09)

Table 2
The Independent Samples Test Between the Mean Attachement Preference Scores in Adults (n=27) and Adolescents (n=23)

Attachment preference scores				
	t	df	Sig. (2-tailed)	95% Confidence Interval of the Difference
	-5.496	48.00	<.001	[-.30; -.13]
	-5.739	41.70	<.001	[-.28; -.13]

As shown in Table 2, the participants' age significantly affected female Persian learners' attachment preference ($t=-5.49_{(48)}$; $p=<.001$). In more specific terms, adolescents showed a DP1 preference, and adults preferred DP2.

The Effect of Presentation Modes on Attachment Preferences

Table 3
Descriptive Statistics for Different Presentation Modes Scores in All Participants (n=50)

Different Presentation Modes Scores	N	Mean (SD)	Min-Max
Offline test	16	.37 (.12)	.20 .66
Online timed test	17	.21 (.20)	.00 .60
Online self-paced test	17	.55 (.09)	.40 .70
Total	50	.38 (.20)	.00 .70

According to the results, there was a statistically significant difference among the three modes of presenting materials ($F=23.78_{(2,47)}$, $p=<.001$). Therefore, the mode of presenting RC had a significant effect on the participants' attachment preferences. In order to locate the place of the difference, the post-hoc test was run. The results indicate that presenting RCs in a self-paced online mode led to a significant difference from the other two modes.

The Effect of Segmentation on Attachment Preferences

Table 4
Descriptive Statistics Comparing Holistic Presentation of Material with Segmented Presentation (n=50)

	N	Mean (SD)	t	Sig. (2-tailed)	df
Holistic	33	.29 (.18)	-5.588	<.001	48.00
Segmented	17	.55 (.09)	-6.851	<.001	47.92

Based on the results presented in Table 4, RC segmentation played a significant role in the participants' attachment preferences. Holistic presentation led to DP2 preference, while segmented presentation induced DP1 preference among the learners.

Discussion

The present study explored the effects of learner age, presentation modes (online/offline), and RC segmentation on the attachment preferences of female Persian learners of English. In total, DP1 attachment preference was more frequent among the learners. More specifically, in the majority of the experimental sentences, Persian female learners selected the first DP as the RC antecedent. It was found that the participants' age significantly impacted the attachment preferences in that the adolescents showed a DP1 preference. Concerning age, our results buttress the study of Frenck-Mestre (1997), which examined RC attachment preferences in temporarily ambiguous French sentences among native speakers and beginning adolescent L2 learners with English or Spanish as their L1s. An overall high-attachment preference was found for adolescent native speakers and Spanish L2 learners, and no preference for English L2 learners. Frenck-Mestre attributed this finding to L1 transfer. Moreover, most studies on the native speakers of English show a low-attachment preference. Given this, L1 transfer in the case of English learners should produce a low-attachment preference (rather than no preference). In fact, the results reported by Frenck–Mestre (1997) are in line with the findings of the present research in terms of DP1 attachment preference among adolescent L2 learners. In addition, the present research findings about DP1 attachment preference are similar to those of Cuetos and Mitchell (1988), who claimed that Spanish parsers (adolescent L2 learners) preferred attaching the incoming items to the first DP or high attachment.

The second research question addressed RC presentation mode in influencing the attachment preferences of learners. The findings showed that the online self-paced mean score was higher (DP1 preference) compared to that of the other modes. In this respect, the results of the present study are in line with the study by Papadopoulou and Clahsen (2005), whereby acceptability judgment and self-paced reading experiments consistently showed that lexical and/or thematic properties of the antecedent affected the RC attachment. Despite such studies, findings on L2 learners' processing of ambiguous sentences in real-time are still inconclusive (Juffs, 2001). In this study, we noted that in an offline mode, though there was ample time to think about the proper antecedent, learners preferred DP2 attachment. In the online timed mode, learners had DP2 preference, whereas they opted for DP1 preference in the online self-paced mode. This finding is in line with the previous studies in that their findings are also conflicting, and still, researchers do not precisely know how L2 learners tend to process sentences in real-time (see Klein, 1999). In the present study, it seems that our L2 learners transferred their sentence processing strategies from their L1 (Persian), in which DP1 is the preferred antecedent. This finding accords with the previous research which has found learners transfer their L1 parsing strategies to L2 parsing (see Fernandez, 1999; Kim & Christianson, 2017). However, it should be conceded that there is inadequate evidence as to why the online self-paced presentation of RCs leads to DP 1 preference (see Klein, 1999).

The last question explored the roles RC segmentation played in the participants' attachment preferences. It was found that the segmentation of the experimental sentences played a significant role in the participants' attachment preferences. When the sentences were presented in segments, the participants opted for DP1. However, this was not the case in the holistic presentation, and DP 2 was preferred. These findings corroborate the Implicit Prosody Hypothesis (Fodor, 1998), claiming that intra-lingual variation influences attachment preferences. According to this hypothesis, dividing the elements of a sentence into different phrases and parts affects syntactic parsing, which resolves the ambiguity. According to the Implicit Prosody Hypothesis, this segmentation might have made the participants insert a pause after the second DP. The insertion of this pause might have created a prosodic boundary, which blocked the attachment of the RC to DP2. As a result, the participants ascribed the RC to the head of this chunk, DP1. Therefore, the syntactic disambiguation of the structurally ambiguous sentences might result from the prosodic packaging of different sentence elements. Consequently, we cannot deny that there are variations in parsing in general and ambiguity resolution in particular, which might arise from differences in segmentation.

In total, there was a higher DP1 preference among Persian learners, substantiating Marefat and Meraj's (2005) reports on parsing preferences (early vs. late closure) of the native and L2 learners of both English and Persian when they read ambiguous RCs. The results revealed the monolingual Persian speakers' significant preferences for high attachment or DP1 (early closure), whereas monolingual English speakers showed a high preference for low attachment or DP2 (late closure). The results also indicated that bilinguals adopted the same parsing strategy as in their L1, suggesting that their L1 might influence the processing of RCs in L2. Similarly, in the present study, DP1 was selected more than DP2, which corroborates Marefat and Meraj's (2005) study on the Persian Learners of English. These findings corroborate the idea that learners transfer their L1 RC preferences (DP1 in Persian) to L2, which supports the Transfer Hypothesis in RC attachment studies.

Conclusion

The overarching aim of the present study was to determine if the female Persian learners of English opted for DP1 or DP2 in resolving RC ambiguity in ambiguous English sentences, depending on whether the sentence was presented in a segmented or holistic manner or whether the task was online or offline. RC ambiguity resolution was also examined in light of the age variable. The findings depict that the variations in attachment preferences in ambiguous RCs might have been partly the result of methodological differences since both segmentation and different ways of presenting the RCs impacted the participants' attachment preferences. This implies that the conflicting findings in the literature can be traced back to the methodological differences and cautions future researchers to consider this point in discussing their findings.

Research findings on whether L2 learners can achieve native-like patterns of ambiguity resolution are still less than conclusive, and conflicting findings seem to suggest that L2 learners employ fewer automatized parsing strategies compared to the native speakers. In the present study, the Persian learners showed different attachment preferences than the English speakers, which might have emanated from their non-native-like parsing of RCs or transfer of L1 attachment preferences. As regards the transfer of L1 parsing strategies to L2 parsing, the results are far from conclusive and even at odds with some studies reporting no transfer of L1 parsing strategies and some, like the present study, suggesting the occurrence of this transfer. Thus, this issue warrants further research to help secure more robust and conclusive results.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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