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Processing Referentially Ambiguous Pronouns by Adult Learners of English as a Foreign Language

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ABSTRACT

Introduction: Processing ambiguous pronouns by L1 speakers of English has been the subject of a great bulk of research. Only a few studies, however, have investigated the ambiguity resolution of pronouns by people for whom English is a second or foreign language. In this study, the researchers employed a picture selection task to explore how adult Iranian EFL learners treated ambiguous pronouns.

Methodology: The materials were 20 experimental items in four different conditions (i.e., manipulation of neither noun phrases [NP1] nor NP2, NP1 manipulation, both NPs manipulation and NP2 manipulation) plus 30 filler items. The principal purpose of this study was to investigate whether the manipulation of NPs by attaching extra content/semantic information to them had any impact on their accessibility and how the participants associated ambiguous pronouns with NPs when attempting to choose an antecedent.

Results: The results confirmed the idea that increasing the length of an NP is an important mechanism employed by EFL learners in the process of ambiguity resolution of pronouns. The results also indicated that the NP length mechanism was a better predictor of accessibility in comparison with other mechanisms, such as the primacy effect, the subject rule, and the grammatical role.

Conclusion: The findings demonstrated that when an NP carries extra-linguistic information compared to other NPs, it might have a better chance of being selected as the referent of an ambiguous pronoun.

1. Introduction

How users of a language treat pronouns have received particular attention by and sparked interest among psycholinguists. In fact, interpretation of pronouns has proved to be problematic for comprehenders on a number of occasions as they can be a source of ambiguity. The main question is how listeners/readers recognize the referent when a pronoun such as *he* is ambiguous in terms of interpretation in a sentence like *David slapped Joseph. He was angry*. This has led researchers to conduct different studies to investigate how listeners/readers decide on the referent of an ambiguous pronoun. Furthermore, what mechanisms are involved in the act of pronoun ambiguity resolution is a question which has been partly answered.

Research has focused on the ambiguity resolution of pronouns from various perspectives. Over the past few decades, researchers have suggested a number of mechanisms which might play a role in the ambiguity

resolution of pronouns. For example, Gernsbacher (1989) considers what she refers to as the advantage of coming first to be a mechanism which might have a considerable impact on resolving pronoun ambiguity. In the example sentence mentioned above, there are two noun phrases (NP), namely *David* and *Joseph*. The mechanism of the advantage of coming first suggests that the NP mentioned first in the sentence, that is *David*, is more likely to be selected as the referent of the ambiguous pronoun *He*. Other researchers have suggested other mechanisms that comprehenders may employ when attempting to find the referent of a pronoun. These include the grammatical role (e.g., Chambers & Smyth, 1998; Sheldon, 1974; Smyth, 1994; Stevenson et al., 1995), the subject rule (e.g., Arnold et al., 2000; Crawley et al., 1990; Frederiksen, 1981; Sekerina et al., 2004), the primacy effect (e.g., Carreiras et al., 1995; Gernsbacher, 1989; Gernsbacher et al., 1989;

Gernsbacher & Hargreaves, 1988), enhancement (Gernsbacher, 1989), and suppression (Gernsbacher, 1989). Despite the relatively well-established literature on the mechanisms employed by listeners/readers during pronoun ambiguity resolution, it is still unclear whether there are other mechanisms that might influence the process. Furthermore, it still remains an open question whether one utilizes one source of information or more at the same time to resolve the ambiguity of pronouns. Moreover, whether one mechanism takes precedence over others in resolving ambiguity has not yet been much investigated. Most studies on ambiguity resolution of pronouns in English have focused on comprehension by individuals for whom English is the first language. However, ambiguity resolution of pronouns by learners of English as a second language (L2) and English as a foreign language (EFL) has not been given adequate attention.

The present study aims to fill the above-mentioned gaps by investigating how Iranian adult advanced EFL learners process and treat ambiguous pronouns. This study also attempts to explore whether the amount of content/semantic information that potential antecedent NPs carry (henceforth referred to as *antecedent NP length*) can influence resolution of ambiguous pronouns by adult Iranian advanced EFL learners. This will be done by manipulating potential antecedent NPs by attaching extra linguistic information to them and thus making them more salient. Another objective of the present study is to draw a comparison between the impact of subject-preference rule, the primacy effect, the grammatical role and antecedent NP length as potential mechanisms for resolving pronoun ambiguity. Thus far, no study, to the best of the researchers' knowledge, has investigated the effect of antecedent NP length as a potential mechanism on ambiguity resolution of pronouns by adult EFL learners. The findings of the current study can hopefully shed light on how Iranian adult EFL learners treat pronoun ambiguity. The results may also contribute to developing a new model of pronoun ambiguity resolution by investigating a potentially new mechanism.

As stated above, research on the ambiguity resolution of pronouns is relatively well-established. Studies have not been limited to English, and researchers have also paid attention to the ambiguity resolution of pronouns in other languages, such as German (Frey, 2004; Hemforth et al., 2010), French (Doherty, 2001; Hemforth et al., 2010), Finnish (Jarvikivi et al., 2005; Kaiser & Trueswell, 2008), Spanish (Carreiras et al., 1995). For example, Jarvikivi et al. (2005) investigated how order of mention and grammatical role can influence resolution of ambiguous pronouns in Finnish. This is an example of a study making a comparison between two mechanisms used by comprehenders to find a referent for a pronoun to find out which may have a stronger effect on ambiguity resolution.

Gernsbacher and Hargreaves (1988) suggested that *the primacy effect* is what makes an NP more accessible compared to another. That is, NPs mentioned first are likely to be more accessible than those mentioned later in a sentence. This is the case because foundations of

comprehension can be based only on the information initially received. Furthermore, after a foundation is established, subsequent information must be added to it. First-mentioned NPs are therefore more accessible as it is through them that information about the second-mentioned NPs becomes represented. This was supported by the findings of other studies (Gernsbacher, 1989; Gernsbacher et al., 1989), suggesting that the NP that is mentioned first in a sentence is probably a better potential antecedent in comparison with other NPs. In addition, Carreiras et al.'s (1995) findings emphasized the advantage of first-mention even in sentences where the first-mentioned NP was not the grammatical subject of the sentence.

McKoon and Ratcliff (1992) regard what they referred to as *the accessibility factor* as an extremely important factor. They proposed a theory, known as *the Minimalist Hypothesis*, according to which accessibility factors take precedence over others when assigning a referent to a pronoun. They believed that only when there is a sufficiently accessible match for the antecedent does pronoun interpretation take place automatically. In another study, Greene et al. (1992) concluded that accessibility information is what makes easy the task of finding a referent. Antecedents are deemed to have high accessibility only when they have been mentioned very recently; are the topics of the conversation; and/or have few potential competing alternatives in the nearby context.

Another mechanism to consider is known as *the subject rule*, which is believed to have a potential impact on ambiguity resolution of pronouns. The subject rule has also been referred to as *the subject-preference account* (Crawley et al., 1990), according to which language users tend to choose the syntactic subject of the preceding clause as the antecedent of an ambiguous pronoun. Frederiksen (1981) found that in the case of sentences beginning with a pronoun which referred to the subject of the preceding clause rather than the object, reading times were faster. Arnold et al. (2000) used the head-mounted eye-tracking system to record participants' eye movements. Their results indicated that the participants did not immediately move towards a correct interpretation when the true referent was an NP other than the subject. However, they looked equally at both NPs for a while. This is because the subject rule was strong enough to create some sort of competition between the two potential antecedent NPs, even when the unambiguous visual context provided a hint as to which NP was more likely to be the referent. Sekerina et al. (2004) conducted a study in which they explored how children and adult L1 speakers of English resolved the ambiguity of short-distance pronouns. The participants were given two pictures followed by a sentence (i.e., "The boy has placed the box behind him.", p. 124) and they were asked to choose the picture which they thought would match the sentence. In each picture, there was a man and a small boy. In one picture, the boy has put the box behind himself; however, the other picture illustrated that the boy has put the box behind the man. In this task, there are two

potential referents, namely *the boy*, and *the man*. They concluded the NP *the boy* is may be “more accessible than the discourse referent *the man* because *the boy* is the grammatical subject of the clause and occurs in the sentence itself, rather than the surrounding context” (Sekerina et al., 2004, p. 124).

Gernsbacher (1989) suggested two general, cognitive mechanisms that may potentially play a role in many language comprehension phenomena. One of these mechanisms is called *enhancement*, which is believed to improve accessibility of previously mentioned concepts by boosting their activation. In contrast, the other mechanism known as *suppression* is considered to improve the accessibility of one concept by hindering the activation of the other concept(s). Both mechanisms might also play a part in how listeners/readers access the appropriate antecedent for an anaphor. An antecedent becomes more accessible due to its enhancement, that is, its activation level is augmented. Furthermore, an antecedent becomes more accessible if other concepts are suppressed. In other words, a concept might stand at the top of the pyramid of potential referents because the activation levels of other concepts are decreased. Thus, enhancement might augment the antecedent's activation, and suppression might decrease the activation of non-antecedents. Accordingly, what triggers these two mechanisms is the information that specifies the antecedent's identity. It is believed that the most available source of such information is the anaphor itself. However, anaphors are different in how much information they provide about their antecedents. Some anaphors, such as repeated NPs, are very explicit; therefore, they exactly match their antecedents. Other anaphors, however, such as personal pronouns, are less explicit, and they often match several potential antecedents. Hence, the information required to identify their antecedents comes only from sources that are external to the anaphors (Gernsbacher, 1989).

Another mechanism that is believed to affect pronoun ambiguity resolution is called *the grammatical role*. Sheldon (1974) and Smyth (1994) suggested *parallel function hypothesis*, based on which a pronoun with two or more potential antecedents in a preceding clause is likely to be co-referenced with the NP with the similar grammatical role. This was supported by the results of other studies (Chambers & Smyth, 1998; Stevenson et al., 1995), which reported that readers preferred NPs as antecedents which had the same grammatical role as the pronoun. They observed that, for an object pronoun, readers preferred as antecedent the object NP in the preceding clause. This finding cast doubt on the veracity of the first-mention advantage in all cases. However, in all these studies, the clauses consisting of the potential antecedents and the pronoun were almost identical in semantic terms, which led researchers to consider the possibility of semantic factors contributing to preferring one NP to another.

One question that has captured researchers' attention is whether the amount of information attached to an NP has

any impact on accessibility of referring expressions. Given functional-linguistic theories of reference (e.g., Ariel, 1990), it is believed that the amount of information attached to an NP plays a central role in making a potential referent highly accessible. For example, according to Ariel's (1990) accessibility hierarchy, longer NPs are generally utilized when the referent is less accessible in the context as they refer to new information in discourse. On the other hand, shorter NPs are more commonly used when the associated referent is more accessible (Ariel, 1990; Givón, 1989). In other words, Ariel (1990) believed that the amount of information an NP carries with it shows how accessible the referent is (i.e., the shorter the NP, the more accessible the referent in discourse). Therefore, there should be a higher tendency towards reduced referring expressions (e.g., pronouns) following shorter NPs.

On the other hand, there is another account assuming that lengthier NPs are more accessible than shorter ones, since more information tends to result in richer memory representations. According to a number of studies of memory (e.g., Fisher & Craik, 1980; Marks, 1987), extra elaborative information attached to words promotes later retrieval of them. This is because extra information provides cues which make later retrieval easier. Thus, there is a possibility that retrieving longer antecedents from memory is easier compared to shorter ones. Similar to this account, Hofmeister (2011) reported that antecedents which were semantically richer led to faster reading times in long-distance dependencies in comparison with those antecedents which were semantically poorer. Karimi et al. (2014) investigated whether antecedent length has any effect on choice of the type of referring expression to that antecedent (pronoun vs. repeated noun). They performed three experiments and found that the participants tended to produce more pronouns when the referent was carrying extra linguistic information. This was consistent with Hofmeister's (2011) findings, which gave credence to the semantic richness account.

Even though psycholinguists have attempted to discover what mechanisms are at work to resolve pronoun ambiguity, it has remained unclear whether there are other mechanisms which might be used by listeners/readers. The subject rule, the primacy effect, and the grammatical role, to name only a few, are different mechanisms comprehenders use in the process of pronoun ambiguity resolution. However, other factors might also have an impact on how ambiguity is resolved. The present study attempts to take into account the mechanism of antecedent NP length to investigate if it influences the way comprehenders process ambiguous pronouns. In addition, there are only a few studies in the literature that compare various mechanisms. Therefore, the present study is guided by the following research questions:

1. What is Iranian adult EFL learners' preference in resolving ambiguous pronouns?
2. Is there a significant difference in the selection of NPs as antecedents by Iranian adult EFL learners in four different conditions of NP manipulation (i.e., neither NP1 nor NP2; only NP1; both NP1 and NP2; and only NP1)?

2. Methodology

2.1. Participants

A total of 35 male ($n = 14$) and female ($n = 21$) undergraduate students at the University of Tehran, Iran, were selected as the participants for this study. They had been given the Oxford Quick Placement Test before the study to check their proficiency levels. They could be regarded as advanced learners of English as they scored at least 48 or higher in the placement test. The rationale behind this selection criterion, that is exclusion of beginners, was to ensure that the participants were proficient enough to be able to understand and process the sentences in a specified time. They were selected from among students majoring in different fields of Humanities, Science, and Technology. Furthermore, they had passed general English courses and were homogeneous with respect to English proficiency. They had been learning English for a minimum period of two and a maximum of eight years. They were all native speakers of Persian, and their age ranged from 18 to 22. They were all kept naïve to the purpose of the study.

2.2. Instrumentation

2.2.1. Oxford quick placement test

The Oxford Quick Placement Test (version 2) was used as the criterion measure of participants' level of proficiency. The test is divided into two parts, and it consists of 60 items 35 of which are in the form of individual multiple-choice items. The rest 25 items appear in five separate cloze tests, each comprising five items. Those who scored at least 48 or higher were deemed suitable participants for this study.

2.2.2. Picture selection task

The picture selection task used in this experiment required participants to read the sentences first, and then match them with the 'right' pictures according to their understanding. The experimental items in the picture selection task included twenty pairs of pictures of famous cartoon characters. Each pair of pictures was accompanied by two sentences. The names of the two characters were presented in the first sentence. The second sentence was the continuation of the first and it started with a subject pronoun. The two characters were regarded as the potential antecedents for the pronoun. In each of the experimental items in this task, gender of the characters was kept the same. Furthermore, verbs used in the experimental items were selected with caution so that the semantic roles they assign to the NPs and the pronouns would not have any effect on the process of ambiguity resolution. The experimental items in this task appeared in four conditions:

Condition I: NP1+ Verb + NP2. Pronoun (no manipulation)

Condition II: NP1 + Manipulation + Verb + NP2. Pronoun (manipulation of NP1 only)

Condition III: NP1 + Manipulation + Verb + NP2 + Manipulation. Pronoun (manipulation of both NPs)

Condition IV: NP1 + Verb + NP2 + Manipulation. Pronoun (manipulation of NP2 only)

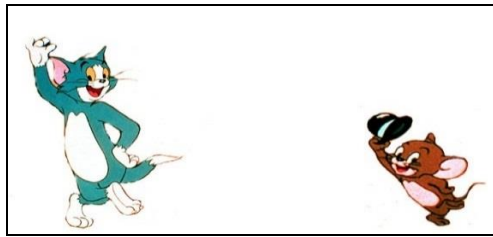
The items in *A*, *B*, *C*, and *D* below are examples of the experimental items in Conditions I, II, III, and IV, respectively (Figure 1).

In order to keep the participants naïve to the purpose of the experiment and camouflage the experimental items, 30 filler items were used. The filler sentences differed from the experimental sentences in that gender or plurality features were manipulated. A random procedure was used to distribute the filler items among the experimental ones. The items in *E* and *F* below are examples of filler items used in the picture selection task (Figure 2).

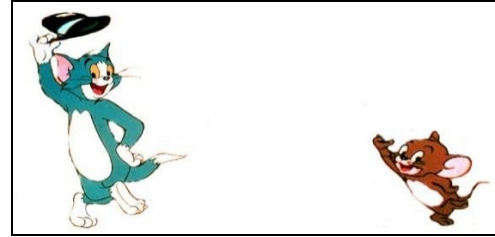
Before the experiment started, the participants had been given time to become familiar with the cartoon characters that were to appear in the task. This was done by showing the pictures of the characters along with their names and gender to the participants several times, and asking them "who" questions. Only after complete familiarity of the participants with the characters did the real task begin. Each pair of pictures along with the sentences accompanying them appeared on the monitor by means of Microsoft PowerPoint Presentation. Each trial lasted for 20 seconds. Two pictures along with two sentences appeared on the screen. Prior to the beginning of the task, the participants had been provided with a thorough explanation of what they had to do during the task. They had been instructed to read the sentences first and then select one of the photos which, according to their understanding, would best match the sentences. The participants were supposed to check either picture *A* or *B* on their answer sheets for each trial. After 20 seconds, each item was replaced with another automatically. If an item was not answered in the allocated time, it was considered missed. The participants were not allowed to go to the previous or subsequent items. The whole process was done automatically by the software. Each participant did the task in an individual session. The whole task lasted for about 20 minutes.

2.3. Data analysis

Once the data were collected, they were analyzed to help us decide whether they were of statistical significance. The statistical procedure we used was the one-way chi-square test since the obtained data were nominal in nature. In addition, we wanted to investigate whether there was a significant difference in the number of times either NP1 or NP2 was selected as the antecedent of the pronouns. The pictures selected gave us clear information about which NP the participants referred the pronouns to. As was previously stated, if the participants were not able to answer an item in the allocated time, they would miss that item. Accordingly, the responses the participants provided were divided into three categories. The first category was given the name *NP1*, and it showed the number of times NP1s were selected as antecedent. The second category was named *NP2*, and it indicated the number of times NP2s



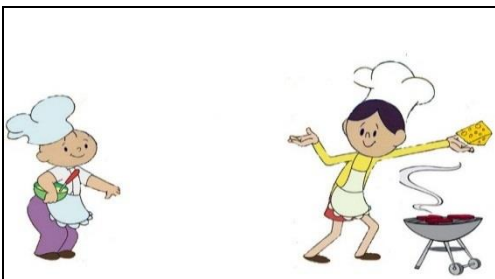
A. Tom saw Jerry. He picked up his hat to say hello.



B. Lolek, holding a bunch of flowers, stood next to Bolek. He was wearing a medal.



C. Lolek, holding a bowl of soup, stood behind Bolek, carrying a piece of cheese. He wanted to cook.



D. Jerry saw Tom wearing a chef hat, fish in hand. He was holding a salt shaker.

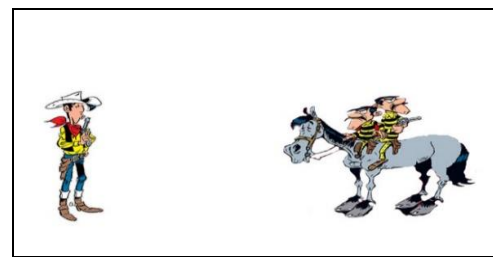


Figure 1.

Examples of the Experimental Items in Conditions I, II, III, and IV



E. Roadrunner was looking at Coyote directly in the eye. He was ready to have the whole cake.



F. Lucky Luke wanted to arrest Daltons. They were riding a horse.

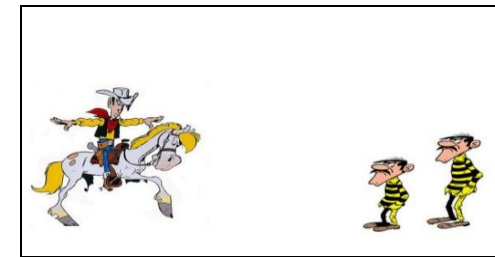


Figure 2.

Examples of the Filler Items

were chosen as referent. Finally, the third category was dubbed *not Attempted* (NA), and it showed the number of times the items were missed. The one-way chi-square test helped us decide if there was a significant difference between the three categories in terms of frequency of occurrence.

3. Results

As mentioned above, the participants either selected *Picture A* or *Picture B* or missed the item. Based on the picture selected, it was decided which NP was selected as the antecedent. There were five experimental items in each condition, and there were 35 participants. Therefore, there were 175 answers for each condition (i.e., $5 \times 35 = 175$). **Table 1** shows the frequency of NPs chosen as the antecedents of the pronouns by the participants in all of the conditions.

Table 1.
The Frequency of NPs Selected as Antecedent in the Four Conditions

	NP1	NP2	NA
Condition I (no manipulation)	154	19	2
Condition II (NP1 manipulation)	138	35	2
Condition III (both NPs manipulation)	123	43	9
Condition IV (NP2 manipulation)	36	136	3

In the first of the four conditions, as was stated before, neither the NP1 (i.e., subject) nor NP2 (i.e., object) was manipulated. In order to investigate whether there was a significant difference between the frequency of occurrence of NP1s and NP2s, a one-way chi-square test was run.

Table 2.
The Results of the Chi-Square Analysis in Condition I

Selected NP	Observed N	Expected N	df	Residual	χ^2	sig
NP1	154	58.3	2	95.7	237.817	.000
NP2	19	58.3	2	- 39.3		
NA	2	58.3	2	- 56.3		
Total	175					

DF: Degree of freedom

Table 3.
The Results of the Chi-Square Analysis in Condition II

Selected NP	Observed N	Expected N	df	Residual	χ^2	sig
NP1	138	58.3	2	79.7	172.537	.000
NP2	35	58.3	2	- 23.3		
NA	2	58.3	2	- 56.3		
Total	175					

DF: Degree of freedom

Table 4.
The Results of the Chi-Square Analysis in Condition III

Selected NP	Observed N	Expected N	df	Residual	χ^2	sig
NP1	123	58.3	2	64.7	117.440	.000
NP2	43	58.3	2	- 15.3		
NA	9	58.3	2	- 49.3		
Total	175					

DF: Degree of freedom

Table 2 shows the results of the analysis in condition I.

Based on the results of the analysis, there is a significant difference in the number of NPs selected as the antecedents of the ambiguous pronouns ($\chi^2 = 237.817$, $p < .05$). As the results suggest, in this condition the NP1s were selected more often as the antecedent of pronouns (observed N = 154) than expected (N = 58.3). Given this, it may be inferred that when there is no manipulation of NPs, comprehenders are more likely to select NP1 as the antecedent of the pronoun. On the other hand, the number of NP2s (observed N = 19) chosen as the antecedent is significantly fewer than NP1s.

The second condition in the experiment was characterized by the manipulation of the first NP. **Table 3** shows the results of the analysis in this condition.

Given the results of the analysis, there exists a significant difference in the number of times NP1s and NP2s were chosen as the referents of the ambiguous pronouns ($\chi^2 = 172.537$, $p < .05$). As the results show, the participants chose the NP1s more often as the referents of the pronouns (observed N = 138) than expected (N = 58.3). Accordingly, we can suggest that when the first NP is manipulated, it is more likely to be selected by comprehenders as the antecedent of the pronoun. On the other hand, the participants selected significantly fewer NP2s (observed N = 35) as referents in comparison with the NP1s.

In condition III of the experiment, both subject NPs and object NPs were manipulated. **Table 4** shows the results of the analysis in this condition.

Considering the results of the analysis, there is a significant difference in the number of times the NP1s and NP2s were chosen as the antecedents of the ambiguous pronouns ($\chi^2 = 117.440$, $p < .05$). As the results indicate, the NP1s were selected more frequently as the antecedents

Table 5.*The Results of the Chi-Square Analysis in Condition IV*

Selected NP	Observed N	Expected N	df	Residual	χ^2	sig
NP1	36	58.3	2	- 22.3		
NP2	136	58.3	2	77.7	164.446	.000
NA	3	58.3	2	- 55.3		
Total	175					

DF: Degree of freedom

of the pronouns (observed N = 123) than expected (N = 58.3). Thus, it seems that when both the subject NP and object NP are manipulated, comprehenders are more likely to choose subject NP as the antecedent of the pronoun. Furthermore, the number of the NP2s (observed N = 43) selected as antecedents is significantly fewer than the NP1s.

Finally, in the fourth condition of the experiment, the NP2s were manipulated. Table 5 illustrates the results of the analysis in condition IV.

As can be seen in Table 5, there is a significant difference in the number of times the NP1s and NP2s were selected as the referents of the ambiguous pronouns ($\chi^2 = 164.446$, $p < .05$). The results demonstrate that the participants selected the NP2s more frequently as the antecedents of the pronouns (observed N = 136) than expected (N = 58.3). Therefore, we can assume that when NP2 is manipulated, comprehenders are more likely to choose the object NP as the antecedent of the pronoun. In contrast, significantly fewer NP1s (observed N = 36) were selected as antecedents compared to the NP2s.

4. Discussion

In order to closely investigate the resolution of ambiguous pronouns by adult Iranian EFL learners, the potential mechanism of antecedent NP length was taken into account to see whether it had a significant impact on comprehenders' preference when attempting to resolve pronoun ambiguity. According to functional-linguistic theories of reference (e.g., Ariel 1990), the amount of information attached to an NP plays a crucial role in making it a highly accessible referent. It was found that increasing NP length was a means of increasing the accessibility of potential antecedents. The present results indicated that when an NP became more salient in comparison to the other through increasing its length, it had a greater chance of being selected as the antecedent of the ambiguous pronoun. One explanation for this might lie in the idea that when an NP is lengthened, it becomes richer in semantic terms, and thus takes a more salient position in readers/listeners' minds. This highlights the findings of a number of studies (e.g., Hofmeister, 2011; Yamashita & Chang, 2001) which argue that longer NPs have higher accessibility in comparison with shorter NPs, which arises from the idea that additional linguistic material provides more information, and therefore makes an NP semantically richer and more salient compared to other NPs. Another possible explanation is that longer NPs have higher accessibility than shorter ones because additional

information tends to yield to richer memory representations. This is in line with the findings of a number of studies (e.g., Fisher & Craik, 1980; Marks 1987), which reported that additional elaborative information attached to an element aids in later retrieval of that element. Hence, there is a possibility that the tendency towards longer NPs by the participants as antecedents in this study was because they were more easily retrievable from memory compared to the shorter NPs.

As for investigating how adult Iranian EFL learners processed pronoun ambiguity when none of the NPs were manipulated, the results demonstrated that the NP1s were selected significantly more compared to the NP2s. This finding not only confirms the results of the studies that consider the primacy effect to be an important factor in increasing accessibility (e.g., Carreiras et al., 1995; Gernsbacher, 1989; Gernsbacher & Hargreaves, 1988), but also underscores the essential role the subject rule plays in making an NP more accessible (e.g., Arnold et al., 2000; Crawley et al., 1990; Frederiksen, 1981; Sekerina et al., 2004). The findings are also compatible with the similar grammatical role account (e.g., Chambers & Smyth, 1998; Sheldon, 1974; Smyth, 1994; Stevenson et al., 1995). In this condition, the NP1s had the advantage of being the subject of the clause; being mentioned first in the clause (i.e., the primacy effect); and sharing the same grammatical role (i.e., subject) with the pronoun.

With respect to the second condition, where only NP1 was manipulated, the results indicated that the NP1s were chosen significantly more as the antecedents of the pronouns in comparison with NP2s. The results were compatible with studies that emphasized the subject rule as an indispensable mechanism in assigning an antecedent to a pronoun and in increasing the accessibility of an NP (e.g., Arnold et al., 2000; Crawley et al., 1990; Frederiksen, 1981; Sekerina et al., 2004). The results also endorse the studies that regard the advantage of first-mention as playing a primary role in accessibility and selection of a referent for an ambiguous pronoun (e.g., Carreiras et al., 1995; Gernsbacher, 1989; Gernsbacher & Hargreaves, 1988). As the NP1s and pronouns both had the role of subject in sentences in this condition, it can be argued that the results confirm the similar syntactic role account (e.g., Chambers & Smyth, 1998; Sheldon, 1974; Smyth, 1994; Stevenson et al., 1995). As the NP1s were manipulated through increasing their length, and selected more as the antecedents, we may conclude that there might be another mechanism at hand. As was previously stated, a number of researchers have claimed that the amount of linguistic information attached to an NP may play a significant role in

increasing its accessibility. The results for this condition may confirm the findings of studies that view NP length as an important factor in accessibility and assigning an antecedent to a pronoun (Fisher & Craik, 1980; Hofmeister, 2011; Karimi et al., 2014; Marks, 1987; Yamashita & Chang, 2001). The NP1s in this condition were the subject of the clause; were mentioned first; shared the same syntactic role with the pronouns; and finally had the advantage of having additional linguistic information attached to them. It can be argued that all these mechanisms simultaneously resulted in very high accessibility of the NP1s, and thus made them a better candidate as the antecedents of the pronouns.

As for the condition in which both NP1s and NP2s were almost equally manipulated, the findings showed that, like the other previous conditions, NP1s were more preferred by the participants as the referents of the pronouns. The results again support the subject rule (e.g., Arnold et al., 2000; Crawley et al., 1990; Frederiksen, 1981; Sekerina et al., 2004), the primacy effect (e.g., Carreiras et al., 1995; Gernsbacher, 1989; Gernsbacher & Hargreaves, 1988), and the grammatical role account (Chambers & Smyth, 1998; Sheldon, 1974; Smyth, 1994; Stevenson et al., 1995). The most salient feature of this condition was that both NP1s and NP2s were manipulated almost equally. The question that might be raised here is whether attaching extra linguistic information to the NP2 may neutralize the effect of the subject rule, the primacy effect and grammatical role and lead comprehenders to show more tendency towards the NP2s. Since the NP1s and NP2s were both manipulated, it can be argued that the effect of NP2 manipulation was neutralized as the same amount of linguistic information was attached to the NP1s. In other words, the participants had four accessibility mechanisms at their disposal to choose the NP1s as the referents, whereas the NP2s only had the advantage of being lengthy. That is, the NP1s in this condition were the subject; were mentioned first in the sentence; shared the same grammatical role with the pronoun; and were lengthened by carrying extra linguistic information.

Perhaps, the most striking feature of this study was condition IV, where only the NP2s were manipulated. The purpose was to investigate whether the mechanism of antecedent NP length could outdo other mechanisms in increasing the accessibility of NPs. The current findings demonstrated that the participants showed significantly more tendency toward the NP2s as the antecedents of the pronouns. These findings were in contrast with those of the studies that emphasized the advantage of first-mention as a primary mechanism in resolving pronoun ambiguity (e.g., Carreiras et al., 1995; Gernsbacher, 1989; Gernsbacher & Hargreaves, 1988). The NPs mentioned first in the sentence were preferred less as the antecedents of the pronouns. Furthermore, the results indicated that subject rule (e.g., Arnold et al., 2000; Crawley et al., 1990; Frederiksen, 1981; Sekerina et al., 2004) did not have much effect on assigning an antecedent to pronouns, and if any, it was only of secondary effect. With regard to the grammatical role

account (e.g., Chambers & Smyth, 1998; Sheldon, 1994; Smyth, 1994; Stevenson et al., 1995), the results indicated that the participants showed more tendency towards the NPs the syntactic role of which was different from that of the pronoun. This shows that the participants did not take into account this mechanism while attempting to resolve the ambiguity. Even if they did, the effect was not much to outdo that of the NP length mechanism. Given all these, it can be argued that the NP length mechanism endorsed by a number of studies (Fisher & Craik, 1980; Hofmeister, 2011; Karimi et al., 2014; Marks, 1987; Yamashita & Chang, 2001) had a tremendous impact on rendering the NP2s highly accessible. Considering the fact that the NP1s in this condition took advantage of three mechanisms (i.e., the subject rule, the primacy effect and the grammatical role), it is interesting that the NP2 were more favoured by the participants. This can suggest that the mechanism of NP length takes precedence over the other three mechanisms, and it may be the first mechanism employed by comprehenders in the process of ambiguity resolution of pronouns.

Research has demonstrated that listeners/readers use a number of mechanisms when trying to resolve pronoun ambiguity. A number of studies have emphasized the importance of the subject rule (e.g., Arnold et al., 2000; Sekerina et al., 2004) and the primacy effect (e.g., Carreiras et al., 1995; Gernsbacher & Hargreaves, 1988). Research has also indicated that if an NP shares the same grammatical role with a pronoun, it has a greater chance of being chosen as antecedent. In addition, NP length has been shown to influence accessibility (Karimi et al., 2014). Given the importance of the accessibility factor in resolving pronoun ambiguity, it is essential to understand what mechanism or mechanisms play a greater role in ambiguity resolution of pronouns in different contexts. In other words, it seems that when trying to decide on an antecedent for a pronoun, comprehenders use one mechanism prior to others. On the other hand, it can also be argued that one uses different mechanisms simultaneously in resolving ambiguity. The results of this study showed that there seems to be a hierarchy of mechanisms. The implication might be to develop a new hierarchical model of ambiguity resolution in which the NP length mechanism is located in one of the top slots. It should be borne in mind that examples of ambiguity are frequently found in natural language; thus, understanding the process of resolution can be an important area of inquiry in psycholinguistic research.

5. Conclusion

In the present study, processing ambiguous pronouns by adult Iranian EFL learners was investigated. To that end, the effect of carrying extra linguistic information by an NP on pronoun ambiguity resolution was explored. Moreover, different mechanism employed by comprehenders when they try to assign a referent to a pronoun were compared. The findings demonstrated that when an NP carries extra linguistic information compared to other NPs, it is might

have a better chance of being selected as the referent of an ambiguous pronoun.

Although the findings of the current study can shed light on how adult EFL learners process referentially ambiguous pronouns, there were a number of limitations that must be taken into account. One main limitation of this study was that it could not take into account the online processing and resolution of ambiguous pronouns. Research into online processing of ambiguity resolution requires special software which, for a number of reasons, was not available. Therefore, the current study was conducted through an offline task to collect the data. Thus, the findings of the study are limited to offline processing and resolution of pronoun ambiguity. Furthermore, all the participants in this study were adults; therefore, the results cannot be generalized to how children and adolescents process ambiguous pronouns. The participants' working memory span was also not taken into consideration; thus, any possible impacts of their working memory span on their processing were not controlled for. In this study, all the participants were native speakers of Persian. Therefore, if mother tongue in any way influences processing and resolution of pronouns, the findings of the present study cannot be generalized to pronoun ambiguity resolution by EFL learners with differing first language backgrounds.

This study attempted to contribute to the growing body of research investigating ambiguity resolution of pronouns in an EFL context. Due to some practical considerations, however, it left some issues unaddressed that can form the basis for further research. Since many factors might influence comprehension, and hence pronoun ambiguity resolution, they should also be taken into account. One factor which can be of interest for future research is the age of comprehenders. Future research can focus on pronoun ambiguity resolution by children and adolescents EFL learners. Another area for conducting further research relates to the influence of the comprehender's first language on the way they process linguistic input. Therefore, further research can be carried out to see if EFL learners with different L1 backgrounds treat pronoun ambiguity in the same way. Finally, most studies on ambiguity resolution of pronouns have attempted to investigate online resolution of ambiguous pronouns. Therefore, future research can focus attention on using the NP length mechanism in online processing of pronoun ambiguity.

Declarations

Competing interests

No potential competing interest was reported by the authors.

Authors' contribution

Aliakbar Khomeijani Farahani supervised the study and Masoud Motamedynia performed the work. All authors read and approved the final draft of the manuscript.

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