



Anaphor Resolution in Implicit and Explicit Causality Structures of the Active and Passive Types

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1. Introduction

1.1. Basic notions and terminology

The etymology of the word *anaphora* dates back to ancient Greek. The word is a compound word made up of *ana*-back, upstream, back in an upward direction and *phora* meaning the act of carrying. Thus, the whole compound means the act of carrying upstream (Mitkov, 1998).

Halliday and Hasan (1976) have provided a definition which is based on the notions of cohesion: anaphora is cohesion (pre-supposition) which points back to some previous item. Hence, the “pointing back”(reference) is called anaphor and the entity to which it refers is its so-called antecedent.

The process of determining the antecedent of an anaphor is called anaphor resolution. Given that the antecedent and the anaphor refer to the same referent, they are referred to as co-referential. As an example, consider:

1. *My brother is late but he should be here any minute.*

The noun phrase *my brother* is the antecedent for the anaphor *he*. In processing this structure if the parser correctly relates *he* to *my brother*, it is said that the process of anaphor resolution has occurred.

1.2. Cues affecting anaphor resolution

Most of the anaphor resolution processes deal with resolution of anaphors that have noun phrases as their antecedents because anaphor resolution with verb phrases, clauses, and sentences as antecedents is a very complicated task. Normally, all noun phrases (NPs)

preceding an anaphor are regarded as potential candidates for the correct identification of the antecedent of the anaphors. These factors are outlined below.

1.2.1. Grammatical role cues

In anaphor resolution the grammatical positions occupied by the potential antecedents serve as cues to the parser in identifying the correct antecedent. For example in the following structure:

2. John blamed Bill because he didn't really like Bill.

The word John occupies the grammatical subject position while Bill occupies the grammatical object position. The parser is predicted to interpret the referentially ambiguous pronoun as being coreferential with the grammatical subject.

It is also noteworthy to mention that the character occupying the grammatical subject is also the first mentioned noun. This so-called 'advantage of first mention' has been noted by Gerbacher (1989) to enjoy a privileged position in the parser's discourse mode. It is believed that the preference for the first mentioned noun is due to the ease with which the character is accessed by the parser throughout the course of parsing (McDonald & MacWhinney, 1995).

1.2.2. Gender cues

In addition to grammatical position information, gender cues may also facilitate the process of anaphor resolution; consider, for example, the following structures:

3. John blamed Mary because she broke the windows.

4. John blamed Mary because he was angry.

The gender differentiation in the above structures serves as a very strong cue as to which NP the pronouns refer to.

1.2.3. Semantic cues

A particularly strong semantic cue known as 'implicit causality' (Garvey & Garmazza, 1974) can also facilitate anaphor resolution. The concept of implicit causality is a property associated with certain verbs and it manifests its influence by building a bias either towards NP1 or NP2 (Stewart, *et al.* 2000). For example, the verb *fascinate* in the structure:

5. John fascinated Bill because he was so clever.

is referred to as implicit causality information since the pertinent biasing verb is located in the main clause. Sometimes, however, the information found in the subordinate clause can serve as an important disambiguating cue. Such cues are called explicit cause information. For instance, in the structure:

6. *John blamed Bill because he didn't really like Bill.*

The fragment *didn't really like Bill* indicates that the pronoun should be interpreted in a manner consistent with NP2 biasing implicit causality verb. It has been reported that anaphor resolution requires a longer period of time when the explicit and implicit causes are at conflict than when they are consistent (McDonald & MacWhinney, 1995).

Stewart, et al. (2000) refers to verbs of the first type as 'Stimulus-Experiencer' (S- E), and those of the latter type as 'Experiencer-Stimulus' (E-S).

Hence, the cues available for the identification of a pronoun's referent include order of mention, gender, implicit causes (i.e., NP1 biasing verbs), and explicit causes (i.e., NP2 biasing verbs).

1.3. Objectives of the study

The present study seeks to examine the processing of two types of causality structures, namely S-E and E-S types. Moreover, the processing of each type of structure will be examined in the active and passive voices. Thus, the study poses the following questions:

1. Which type of the structures (i.e., S-E vs. E.S) is more facilitative of anaphor resolution? And,
2. Which type of voice (i.e., active vs. passive) is more accommodating of anaphor resolution?

1.4. Hypotheses

Regarding the type of voice, the listener's processing mechanism would be less strained with active structures. The reason for this lower activation load is simply the smaller number of cues impinging on the system. Thus, one may conclude that with active structures the process of anaphor resolution is more easily attainable with respect to the processing of S-E structures of the active voice. This hypothesis gains further support in the light of the principle of 'advantage of first mention' characteristic of S-E structures. Hence, it is anticipated that the processing mechanism will be under less strain than with the passive counterparts of the same type of structure. As a result, the following directional hypothesis may be envisaged for the S-E structures:

$$H1: \bar{X}_{\text{active}} > \bar{X}_{\text{passive}}$$

With regard to the E-S causality structures, however, the argument is somewhat more complicated. On the one hand, in the active form, the advantage of first mention is no longer a factor because if correctly processed the second NP will be identified as the subject of the second clause. Yet, due to the minimal distance between the second NP and the pronoun, it may well be that it is more efficiently retained in the parser's memory for resolution purposes. Furthermore, in the passive voice, in spite of the greater number of

cues exerting their influence on the perceptual channel, the first NP is endowed with the advantage of first mention. Thus, it is not quite clear whether the processing system will be under more pressure in the active or passive voice. Hence, a non-directional hypothesis seems more appropriate for the E-S type of structures:

H1': \overline{X} active # \overline{X} passive

1.5. Significance of the study

The findings of the present study would not only shed light on the routes of L2 processing by EFL learners, but would also aid the practitioners in the ordering of the presentation of causality structures. More specifically, the results of the study could serve as a guide to material developers and teachers in the selection, ordering, and presentation of causal verb types as well as in selecting the type of voice that would most optimally make use of the learner's processing mechanisms and strategies.

2. Method

2.1. The participants

The participants of the study consisted of 80 EFL learners of advanced standing enrolled in levels 11 and 12 of the 'Iran Language Institute', Shiraz branch. The justification for choosing the said participants was that at the time of the experiment, they had passed 14 levels of formal instruction in L2 and were deemed of advanced standing in accordance with ACTFL's criteria for determining the proficiency level of EFL learners. Thus, it stood to reason that the participants would be well familiar with the vocabulary and the structures presented to them via the sentences of the task. There were 35 female and 45 male participants of equi-distant socio-cultural backgrounds.

2.2. The stimuli

The stimuli consisted of 32 sentences. Half of the structures, 16, were of the S-E main clause types and the other half, 16, consisted of the E-S main clause types. Of the 16 structures of each type, 8 structures were constructed in the active voice and the other 8 in the passive.

The main clauses were conjoined to the subordinate clause by using the word *because*. The slot representing the pronoun in the subordinate clause was blanked to be filled out by the participants. The NPs appearing in the main clause consisted of a proper male and a proper female noun. The ordering of the NPs was cross-balanced in order to neutralize any effect of first appearance related to gender.

The following structures are representative of this design:

- S-E Type:**
7. *Cindy amused Harry because _____ was so entertaining.*
 8. *Linda was amused by Peter because _____ was so entertaining.*

- E-S Type:** 9. *Charlie admired Betty because _____ was so intelligent.*
10. *Jack was admired by Jane because _____ was so intelligent.*

2.3. Procedure

The 32 structures were audio-taped and played back one by one to the participants. After the termination of each sentence, three seconds were allowed before the next sentence was played. The reason for implementing such a short time span between the sentences was to enhance the possibility of automatic rather than analytic processing by the participants. This was deemed a necessary step since the aim of the study was to determine how processing takes place in natural environments where the processing mechanism is deprived of the luxury of having time enough to analyze the structure it is exposed to.

The task of pronoun resolution was operationalized by providing the participants with answer sheets to record the pronoun they considered as the referent of the NP in the main clause. Given that the NPs were of different genders, the participant's identification of the referent of the NP was signaled by his choice of the pronouns *he* or *she*.

3. Results and discussion

First, the statistics pertaining to S-E (i.e., NP1 biasing) structures will be reported. Next, the results for E-S (i.e., NP2 biasing) structures will be presented.

3.1. Participants preference for NP1 vs. NP2 in S-E structures

As will be recalled, S-E structures were made of certain verbs that caused the parser to pick NP1 as the referent of the pronoun rather than NP2. Furthermore, the participants preference for either NP1 or NP2 was operationalized through the implementation of gender-differentiated pronouns (i.e., he vs. she).

3.1.1 Participants preference for NP1 vs. NP2 in S-E structures of the active voice

In the active voice, the two cues of 'NP1 bias' and 'advantage of first mention', as illustrated in structure 7 above, converge to hint at the first NP of the main clause as the referent of the pronoun. This rather strong coalition of cues is well vouched for through the [participants'](#) high preference for NP1, 6.80, as opposed to their weak preference for NP2 in the active S-E structures. As table 1 below indicates, this difference was significant at the .01 probability level.

3.1.2. Participants preference for NP1 vs. NP2 in S-E structures of the passive voice

In the passive voice, as structure 8 above illustrates, S-E structures are deprived of the so-called 'advantage of first mention' due to the movement caused by passivization. Thus, one could argue that in the S-E structures of the passive voice, the two cues of 'NP1 bias' and 'advantage of first mention' are competing against one another in directing the parser's attention to the referent of the pronoun.

The participants' performance on the passive voice of S-E structures indicated a mean of 2.15 for NP1 and one of 5.85 for NP2 (See table 1).

Table1. Comparison of mean instances of preference for NP1 vs. NP2 as the referents in the active and passive S-E structures

Voice type	Variable	Mean (Max=8)	# of pairs	SD	t-value	Sig.
Active	NP1	6.80	80	0.649	4.95	p<0.01
	NP2	1.20		0.670		
Passive	NP1	2.15	80	0.743	3.93	p<0.01
	NP2	5.85		0.751		

With respect to testing the hypothesis pertaining to S-E structures of the active and passive voice (i.e., mean of active > mean of passive) another paired t-test was run. The results are reported in the following table:

Table 2. Comparison of mean instances for choosing NP1 as the referent of the pronoun in S-E structures of active and passive voices

Voice type	Variable	Mean	# of pairs	t-value	Sig.
Active	NP1	6.80	80	4.23	p<0.01
Passive	NP2	2.15			

Thus, the evidence quite unambiguously upholds the directional hypothesis posited for S-E structures. More simply stated, the participants preferred NP1 over NP2 as the referent of the anaphor in the active voice of S-E structures; and chose NP2 in the passive voice.

3.2. Participants preference for NP1 vs. NP2 in E-S structures

The E-S structures contained the type of verbs that were either NP2 biasing in nature or the information in the subordinate clause biased the verb toward NP2. Again, the participants' preference for NP1 vs. NP2 was operationalized through their choice of *he* or *she* as the referent of the pronoun.

3.2.1. Participants preference for NP1 vs. NP2 in E-S structures of the active voice

The participants performance on E-S structures of the active voice revealed a definite verb-motivated strategy in pronoun resolution The mean for choosing NP1 stood at 2.30, while the mean registered for NP2 was 5.70. This difference was statistically significant as indicated in table 3 below.

3.2.2. Participants preference for NP1 vs. NP2 in E-S structures of the passive voice

In the passive voice, the positions occupied by NP1 and NP2 were reversed; and in the light of the fact that ES structures are NP2 biasing to begin with, in their passive form their NP1

benefits from both verb bias and advantage of first mention. The following table illustrates that this difference was statistically significant.

Voice type	variable	mean	# of pairs	SD	t-value	Sig.
Active	NP1	2.30	80	.0470	3.75	p<0.01
	NP2	5.70		0.664		
Passive	NP1	6.85	80	0.612	4.99	p<0.01
	NP2	1.15		0.649		

Table 3. Comparison of mean instances of preference for NP1 vs. NP2 as the referents in the active and passive E-S structures

As will be recalled, the hypothesis for the active and passive voices of the E-S structures was of the non-directional type because it was not clear which factor (i.e., verb type or advantage of first mention) would have the greater impact on the parser's perceptual channel. To test the null hypothesis (H0: mean of active=mean of passive) another paired t-test needed to be run. The results are reported in the following table:

Table 4. Comparison of mean instances for choosing NP1 as the referent of the pronoun in E-S structures of active and passive voices

Voice type	variable	mean	# of pairs	SD	t-value	Sig.
Active	NP1	2.30	80	0.470	4.35	p<0.01
Passive	NP1	6.85		0.612		

Hence, one may assert that there exists enough statistical evidence to reject the null hypothesis, and to claim that in the E-S structures, the participants were more inclined to choose NP1 in the passive voice than in the active.

4. Conclusion and implications

The results of the study indicated that out of the three independent variables investigated, namely a) verb type, b) voice type, and c) advantage of first mention, only the first (i.e., verb type) resulted in any statistically significant preference for anaphor resolution. The following table summarizes these findings:

Table 5. Comparison of the effects of verb type, voice type and advantage of first mention in anaphor resolution

Verb type	Voice type	Advantage of 1 st mention	Preference for NP1	Preference for NP2
S-E (NP1 Biasing)	Active	Yes	6.80	1.20
	Passive	No	2.15	5.58
E-S(NP2 Biasing)	Active	No	2.30	5.70
	Passive	Yes	6.85	1.15

As the table indicates, the participants' preference for NP1 as the referent of the pronoun in contrast to their preference for NP2 was strongly influenced by the variable of verb type. In all different instances (i.e., active vs. passive and whether or not the pronoun's referent exhibited advantage of first mention), the participants of this study chose the NP that was biased by the verb as the referent of the pronoun.

Thus, to conclude, one might assert that the participants' choice for the referent of the pronoun was primarily determined by the variable of verb type (i.e., where the verb was biased either towards NP1 or NP2). This conclusion may be regarded as still another piece of evidence for the fundamental role attributed to the verb as the most important constituent of the structure in assigning semantic roles to other components within the structure. Amongst the most influential theories of grammar that are based on the primacy of the verb in assigning theta roles such as Goal, Agent, and Patient roles is the 'VP-Internal Hypothesis' put forth by Koopman and Sportiche (1988). According to this hypothesis all thematic roles are assigned by the verb, and more importantly for the purposes of the present study, the subject of the sentence is base generated inside the VP. In other words, rather than the traditional view that the subject NP node is governed by the S node, under the tenets of the VP-Internal Hypothesis, the subject NP is governed by the VP node. In this light, the findings of this study (i.e., the verb influences pronoun resolution) lend empirical support to the validity of those theories of grammar that attribute a foundational role to the verb of structure.

With respect to the implications of the study, the findings suggest that both the teacher and the material developer must be aware of the importance of the role of the verb in processing anaphor resolution, and that this importance must be highlighted in practice in L2 classes. The teacher for his part could instill in the learners a state of awareness (i.e., consciousness raising) about the fundamental role of the verb in structures requiring anaphor resolution.

As for the material developer, one may argue that the contents of courses requiring anaphor resolution should be centered on the type of the verb and the bias that the verb type results in. Hence, it would be quite logical to introduce S-E structures before E-S ones since their

NP1 biasing verbs exert a relatively lighter load on EFL learners perceptual channel when processing such structures. To aid the material developer in this connection, some of the more frequent verbs of both types together with some structures in which they are configured are listed below:

I. S-E Structures (NP1 Biasing Verbs)

11. Helen **deceived** Carl because she was so intelligent.
12. Brian **inspired** Shirley because he was so enthusiastic.
13. Kathryn **disappointed** George because she was so hard hearted.
14. David **frightened** Helen because he was so unpredictable.
15. Peter **bored** Jane because he was so repetitious.

II. E-S Structures (NP2 Biasing Verbs)

16. Charles **feared** Linda because she was so aggressive.
17. John **pitied** Jill because she was so uncomfortable.
18. Barbara **hated** Bob because he was so manipulative.
19. Lisa **trusted** Tom because he was so persuasive.
20. Sheila **noticed** George because he was so over-dressed.

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