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Looking Back and Looking Forward: Anaphora and Cataphora in Italian

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Abstract

Pronoun interpretation is central for comprehension. Prior work focused mostly on **anaphora**, where pronouns refer to previously-mentioned antecedents. Less research is on **cataphora**, where antecedents follow pronouns. Existing work suggests cataphora triggers an active-search mechanism: The parser actively searches for a syntactically-licenses antecedent. Our results on Italian null and overt subject pronouns show that both processing constraints (“impatient parser”) and the grammatical properties of referring expressions contribute to the outcome of reference resolution; parsers try to “discharge” unresolved pronouns when encountered first (i.e., cataphora) due to a processing load of keeping an unresolved pronoun in memory, even if this goes against grammar specific properties. Furthermore, in line with related research, we find that strong grammatical principles (Binding Theory) are powerful enough to “block” processing effects, contributing to our view of how different components of language processing interact.

Looking Back and Looking Forward: Anaphora and Cataphora in Italian

Emily Fedele and Elsi Kaiser*

1 Introduction

The question of what influences people's interpretation and use of different referring expressions (e.g., *she, him, it*) has been investigated from a range of research perspectives. Prior research has largely focused on identifying what information hearers use to interpret pronouns. Pronouns are semantically under-informative forms and must receive their interpretation from the surrounding context; they do not provide enough information on their own to identify a referent, and yet they are frequently used in language without difficulty. Researchers have proposed various strategies that govern the search for a possible antecedent. This includes attention-driven approaches (e.g., Ariel 1990, see also Gundel, Hedberg and Zacharski 1993 for related work), which are focused on how accessible different entities are in the minds of the speaker and hearer. Simplifying things somewhat, it is commonly agreed that the more accessible the antecedent is, the more likely it is to be referred to using a pronoun. Researchers have also noted that pronouns tend to prefer antecedents in subject positions, perhaps due to subjects being more accessible (Crawley, Stevenson and Kleinman, 1990, among others), while others observed that the subject preference may in fact be part of a Parallel Structure preference (Smyth 1994, Chambers and Smyth 1998), where pronouns are resolved to antecedents that occupy a matching argument position. Recently, Kehler (2002), Rohde (2008), and colleagues have argued in favor of a different approach, which regards pronoun resolution as a side effect of the more general coherence-establishing processes that language users engage in (see Hobbs 1979).

In this paper, we report two experiments investigating how the human language processing mechanism comprehends different kinds of linguistic expressions, in particular null and overt pronouns in Italian. We investigated both anaphora, where a pronoun comes *after* its antecedent (1a) and cataphora where the pronoun linearly precedes its antecedent (1b) (examples from Kennison, Fernandez and Bowers 2009).

- (1) a. *Anaphora*: After Ted arrived, he asked for a cup of coffee
- b. *Cataphora*: After he arrived, Ted asked for a cup of coffee

2 Previous Work on Pronoun resolution

2.1 Existing Work on Cataphora

Prior work on pronoun interpretation has focused on identifying strategies affecting the search for a pronoun antecedent mostly looking at *anaphora*. There is considerably less work on cataphora. In this section we briefly summarize some of the relevant studies on cataphora.

In one of the earliest experiment studies to this topic, Cowart and Cairns (1987) observed a strong preference to interpret a cataphoric pronoun as referring to the first possible noun phrase that is encountered after the cataphor. Van Gompel and Liversedge (2003) conducted an eye-tracking reading study that builds on this work. Using sentences like (2), they manipulated whether the gender of the cataphoric pronoun matches the gender of the subject noun (encountered first) or the object noun (encountered later).

- (2) When she was fed up, the (girl/boy) visited the (girl/boy) very often

The eye-movement patterns show that comprehenders try to link the cataphoric pronoun to the first available noun (the subject), rather than to the second noun (the object). Broadly speaking, van Gompel and Liversedge's results suggest that the parser actively searches for possible antecedents for the cataphoric pronoun, anticipating the upcoming main clause subject pronoun, and creates a referential dependency with that position. Thus, their results are in line with the earlier findings of Cowart and Cairns: Both point to an "impatient parser" that tries to resolve the pro-

noun as early as possible.

In related work, Kennison, Fernandez and Bowers (2009) found that anaphoric pronouns are processed faster than cataphoric ones, which they attribute to an expectation for coreference with an already mentioned antecedent: Anaphoric pronouns do not have to wait for an upcoming referents, whereas cataphoric pronouns do.

Other studies looking at cataphora have highlighted how the anaphor/cataphor distinction is much more complex when we consider languages other than English. Kazanina and Phillips (2010), investigating Russian, show that there is a time-course distinction between two different kinds of constraints affecting cataphoric pronouns: (i) a Russian specific constraint with cataphora, banning coreference between a main clause subject and subordinate clause pronoun when the connective is *poka* “while” and, (ii) Principle C of the Binding Theory, a grammatical constraint ruling out coreference between a pronoun and any referring expression that it c-commands (Chomsky 1981, Reinhart 1983). Principle C essentially fully blocks the consideration of any antecedent that would violate this constraint, while the Russian specific constraint acts as a “delayed” filter, where a restricted antecedent is originally considered before being ultimately filtered out of consideration.

Summarizing, existing research on cataphora has identified specific differences in processing of anaphoric and cataphoric pronouns: Anaphoric pronouns are processed more quickly than cataphoric ones due to a preference for coreference with already mentioned referents, whereas cataphora involves an “active-search mechanism” that aims to identify the possible antecedent as soon as possible. In addition, Kazanina and Phillips (2010) found language-particular vs. more universal constraints can differ in how effective they are in guiding reference resolution.

2.2 Reference Resolution in Italian: Referential Biases of Null and Overt Pronouns

The impact of the anaphor/cataphor distinction in Italian is central to the ongoing debate concerning what information comprehenders use to guide pronoun interpretation. Italian has both null and overt pronouns: In an anaphoric configuration, null pronouns typically refer to preverbal subjects and overt pronouns typically refer to objects, as in (3). (Example from Carminati 2002). It has also been suggested that overt pronouns can potentially signal a topic shift.

- (3) *Mario_a ha telefonato a Giovanni_b, quando NULL_a/lui_b aveva*
 Mario has telephoned to Giovanni when null/he had
Appena finite di mangiare
 just finished of to eat
 “Mario called John, when he just finished eating”

Existing work on Italian subject pronouns has mostly focused on anaphoric configurations. In her influential dissertation, Carminati (2002) conducted a series of questionnaire studies and self-paced reading experiments with Italian speakers focusing on the referential biases on null and overt pronouns in subject position. Based on the apparent bias of null pronouns to prefer subject antecedents and overt pronouns to prefer object antecedents, Carminati argues in favor of a structural approach to subject pronoun processing, the *Position of Antecedent Hypothesis* (PAH). According to the PAH null pronouns refer to a structurally prominent antecedent in a [Spec IP] position, and overt pronouns refer to an antecedent lower in the clause structure.

Recent evidence looking at anaphora and cataphora and Italian null and overt pronoun preferences seems to be in conflict with Carminati’s PAH, indicating that null and overt subject pronoun interpretation is not necessarily as straight forward as previously thought. For example, the results of Belletti, Bennati and Sorace’s (2007) experiments diverge from the predictions of the PAH for null and overt pronouns in anaphora and cataphora configurations. In particular, they found that null pronouns overwhelmingly prefer the *object* of the main clause in anaphoric configurations. They also observed that overt pronouns have a very varied interpretation in cataphoric configurations: they prefer neither the subject nor expected object antecedent, and instead mostly refer to an extralinguistic referent. These findings seem to go against both the PAH and the previously-observed grammar specific tendencies of Italian null and overt pronouns to prefer subject and ob-

ject antecedents, respectively.¹

Further evidence regarding the importance of the anaphor vs. cataphor distinction comes from Serratrice (2007). In her study, null pronouns had an overall subject preference which was enhanced in cataphoric conditions; this does not quite align with Belletti et al.'s finding that null pronouns prefer the object in anaphoric conditions. In cataphoric conditions, she found that overt pronouns mostly preferred an extralinguistic referent, similar to Belletti et al.

As a whole, the findings from Belletti et al. 2007 and Serratrice 2007 conflict in some respects and thus highlight a need for further study. In addition, as a whole they show that pronouns have different referential behavior in anaphoric vs. cataphoric configurations, and suggest that the Position of Antecedent Hypothesis would need to be extended in order to capture cataphoric conditions.²

3 Present Study

The present study investigates anaphora and cataphora in Italian with two main claims. The first is to explore the interplay between processing biases (i.e., the active search mechanism) and linguistic, form-specific referential biases (i.e., preference for preceding subject vs. object). The second main aim is to clarify form-specific biases of null and overt pronouns, given that existing findings are mixed. By looking at the effects of clause-order and anaphor/cataphor distinction on antecedent preference, we can learn more about how different factors influence reference resolution, and more generally, how the human processing mechanism comprehends different referring expression.

We investigated these issues by conducting two off-line web-based questionnaire studies manipulating (i) clause-order (anaphora/cataphora), and (ii) pronoun-form (null vs. overt). The two experiments differed in placement of the pronoun: in Experiment 1, the pronoun was in the subordinate clause, while in Experiment 2, the pronoun was in the main clause.

3.1 Experiment 1: Pronoun in Subordinate Clause

Experiment 1 investigated how comprehenders interpret null and overt subject pronouns in Italian in anaphoric and cataphoric contexts. We manipulated (i) clause-order (anaphora/cataphora), and (ii) pronoun form (null/overt). On target trials, the critical pronoun was always located in the subordinate clause. We wanted to test whether and how the referential biases of overt and null pronouns are influenced by the distinction between anaphoric contexts (antecedents encountered before the pronouns) and cataphoric contexts (antecedents encountered after the pronouns).

3.1.1 Method

Twenty-four native speakers of Italian participated in a web-based questionnaire that we created using Qualtrics. Participants read sentences and answered questions probing pronoun interpretation. The study included 16 targets and 28 fillers. In target items, we manipulated clause-order (anaphora/cataphora) and pronoun form (null/overt), for a total of four conditions: (i) SVO/null, (ii) null/SVO, (iii) SVO/overt, (iv) overt/SVO. In the examples below, we use an underscore to denote the null; no underscore was included in the actual sentences shown to the participants.

All targets involved a “while” relation (Italian, *mentre*). This allowed for us to keep the semantic relations constant, which is important since Kehler (2002), Rohde (2008) and others have shown that they influence pronoun interpretation. All targets used the present tense, and were constructed so both referents are semantically plausible referents for the null or overt pronoun. Sam-

¹While Belletti et al. (2007) were not directly looking at the effect of clause-order on Italian subject pronoun interpretation, it is clear from their divergent results for anaphora and cataphora, that clause-order seems to have an important effect on the search for a possible antecedent.

²Several studies have investigated the Position of Antecedent Hypothesis (PAH) in Spanish and Catalan, with varying results for inter- and intra- sentential pronominal dependencies (Alonso-Ovalle, Fernandes-Solera, Fraizer and Clifton 2002, Mayol and Clark 2010, de la Fuente and Hemforth (submitted)). Taken together, these studies show a lack of a bias for both null and overt pronouns in Spanish and Catalan. While Spanish is outside the scope of the present work, it is clear that there are other factors at work affecting null and overt pronoun biases cross-linguistically. See Gerber 2006 for an investigation of the PAH in Romanian.

ple items for the 4 conditions are given in (4).

- (4) a. SVO/null
Maria abbraccia Rita, mentre ___ parla del viaggio a Londra
 Maria hugs Rita, while null speaks about-the trip to London
- b. null/SVO
Mentre ___ parla del viaggio a Londra, Maria abbraccia Rita
 While null speaks about-the trip to London, Maria hugs Rita
- c. SVO/overt
Maria abbraccia Rita, mentre lei parla del viaggio a Londra
 Maria hugs Rita, while she speaks about-the trip to London
- d. overt/SVO
Mentre lei parla del viaggio a Londra, Maria abbraccia Rita
 While she speaks about-the trip to London, Maria hugs Rita
- (5) *Chi parla del viaggio a Londra?*
 Who talks about-the trip to London
- a. Maria
 b. Rita
 c. Qualcun altro (“someone else”)
 d. Entrambi/e (“could-be-either”)

All targets involved a “while” relation (Italian, *mentre*). This allowed for us to keep the semantic relations constant, which is important since Kehler (2002), Rohde (2008) and others have shown that they influence pronoun interpretation. All targets used the present tense, and were constructed so both referents are semantically plausible referents for the null or overt pronoun. Sample items for the 4 conditions are given in (4).

In this experiment, the critical pronoun was in the subordinate clause, and two potential antecedents were in the matrix clause, as in (4). (In Experiment 2, the pronoun is in the main clause). The pronoun and two antecedents matched in gender; gender was balanced across the 16 targets (8 female, 8 male). Following each experimental item was a question asking about the referent of the pronoun, with four answer choices, as in (5): the subject name, the object name, (c) *Qualcun altro* “someone else” (i.e., an extra-linguistic referent), and (d), *entrambi/e* “could be either one”. The answer choices were presented in terms of the names of the referents (not presented in terms of grammatical roles).

3.1.2 Results

The results are shown in Figure 1. Overall, the null pronoun behaves as predicted, preferring the subject antecedent regardless of clause-order. Crucially, however, this preference is *weaker with anaphora*: in the anaphor condition (SVO/null), 78% of nulls were interpreted as referring to the subject antecedent, and in the cataphor condition (null/SVO), 85% of nulls were interpreted as referring to the subject antecedent. The overt pronoun conditions show even clearer effects of the anaphor-cataphor distinction: In the anaphor condition (SVO/overt), overt pronouns tend to be interpreted as referring to the preceding object (76%). In the cataphor condition (overt/SVO), there is no sign of an object preference: participants’ choices seem to be evenly split between subject, object, and other.

To assess these patterns statistically, we performed two-way repeated analysis of variance (ANOVAs) on the proportion of subject choices and object choices, with the factors being clause-order (anaphora/cataphora) and pronoun form (null/overt).

Proportion of subject choices: There is a main effect of form ($F_1(1,23)=80.457, p<.05, F_2(1,15)=63.552, p<.05$), with null pronouns triggering a higher rate of subject choices than overt pronouns. We found no effects of clause-order in the by-subjects analysis, but we found a significant effect in the by-items analysis ($F_1(1,23)=2.791, p=.108, F_2(1,15)=12.097, p<.05$). Numerically, there are more subject choices in the cataphor condition than in the anaphor. There was no interaction between order and pronoun form, $F_1(1,23)=.814, p=.376, F_2(1,15)=1.250, p=.281$.

Proportion of object choices: We again find a main effect of form ($F_1(1,23)=53.599, p<.05,$

$F_2(1,15)=100.443, p<.05$), with overt pronouns triggering a higher rate of object choices than null pronouns. There is also a main effect of clause order ($F_1(1,23)=21.231, p<.05, F_2(1,15)=45.00, p<.05$) and a form X clause-order interaction ($F_1(1,23)=11.603, p=.05, F_2(1,15)=9.639, p<.05$).

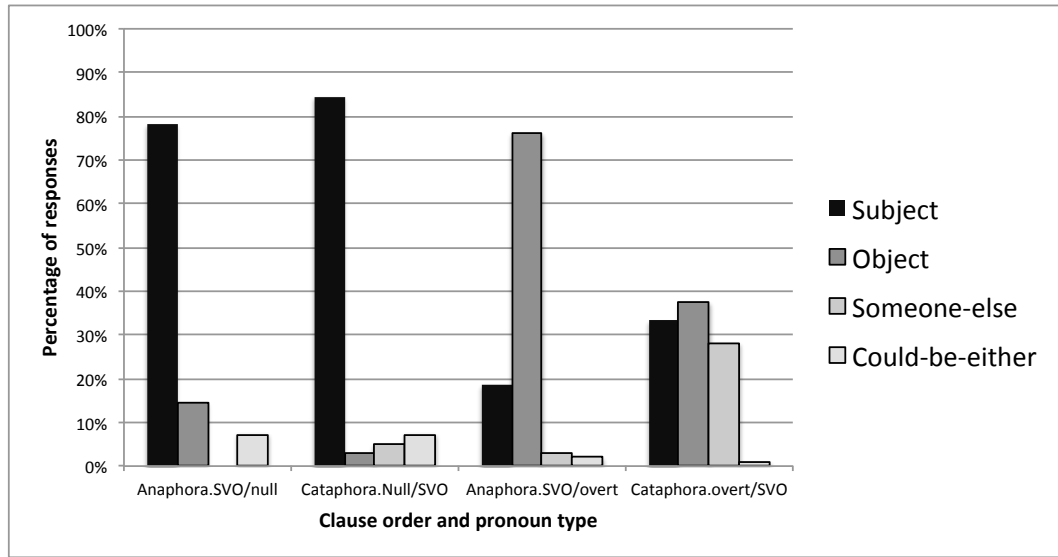


Figure 1: Antecedent choices for null and overt pronouns (pronoun in subordinate clause).

To further explore the source of the interaction, we used paired t-tests. Let us first consider null pronouns and then turn to overt pronouns. With *null pronouns*, when we compare the anaphor and cataphor conditions, we find no significant differences in the rate of subject choices. However, null pronouns trigger significantly more *object choices* in the anaphor condition (SVO/null) than in the cataphor condition (null/SVO, $t_1(23)=2.298, p<.05, t_2(15)=2.711, p=.016$). In other words, the subject preference of null pronouns is stronger in the cataphor condition.

With *overt pronouns*, we also find effects of the anaphor-cataphor distinction, but in the opposite direction: When we compare the anaphor and cataphor conditions, we find significantly more object choices in the anaphor condition (SVO/overt) than in the cataphor condition (overt/SVO, $t_1(23)=4.758, p<.05, t_2(15)=5.565, p<.05$), as well as more subject choices in the cataphor condition than in the anaphor condition (significant by items, but not by subjects; $t_1(23)=-1.595, p=.124; t_2(15)=-2.671, p<.05$). Thus, now we see that the object preference of overt pronouns is stronger in the anaphor condition.

In sum, these results indicate that the anaphor/cataphor clause-order distinction plays an important role in guiding the interpretation of null and overt pronouns, and modulates the referential biases of null and overt pronouns in seemingly opposite directions.

3.1.3 Discussion

Experiment 1 supports existing claims that null and overt pronouns differ in their referential biases: the null pronoun prefers subject antecedents, and overt pronouns prefer object antecedents (Carminati 2002, Belletti et al. 2007). However, we also find that the strength of these preferences is modulated by the anaphor/cataphor distinction in important ways: The referential bias of *null pronouns* to prefer subject antecedents is stronger in the cataphoric configuration than in the anaphoric configuration. Conversely, the referential bias of *overt pronouns* to prefer object antecedents is stronger in the anaphoric configuration than in the cataphoric configuration.

Why should the anaphor/cataphor distinctions impact null and overt pronouns in such different ways: Why would the *anaphor configuration* strengthen the bias of overt pronouns when the *cataphor configuration* strengthens the bias of null pronouns? We suggest that this seemingly odd asymmetry actually follows straightforwardly from processing principles. More specifically, we attribute this asymmetry to the processing load associated with holding a (cataphoric) pronoun

unresolved in memory. Let us assume that the “impatient” parser actively searches (van Gompel and Liversedge 2003) for a potential antecedent, in order to “discharge” an unresolved (null/overt) pronoun as early/as quickly as possible. In this situation, if it encounters a pronoun before the potential antecedents (cataphoric configuration), the parser will try to link that pronoun to the first potential antecedent that it encounters, in order to minimize processing load. Crucially, given that subjects precede objects (in our sentences), this means that the parser will have a preference to interpret the unresolved cataphoric pronoun as referring to the subject. This strengthens the subject preference of null pronouns but weakens the object preference of overt pronouns; with overt pronouns, the form-specific object preference is pitted against the parser’s preference to resolve the dependency as quickly as possible.

In sum, building on earlier findings showing that cataphora trigger an active search process for a potential antecedent (van Gompel and Liversedge 2003) we suggest that the seemingly surprising effects of clause order on overt and null pronouns follow logically from the parser striving to resolve the pronoun as soon as possibly by associating it with the first possible antecedent that it encounters, in our case the subject of the main clause, regardless of whether the pronoun is null or overt.

3.2 Experiment 2: Pronoun in Main Clause

Experiment 1 suggests that the processing bias to minimize unresolved dependencies affects both null and overt pronouns, i.e., ignores distinctions in referential form. The results show that the linear order in which we encounter a constituent affects reference resolution, even if this is going against grammar-specific biases (such as the preference of overt pronouns to refer to objects). Experiment 2 uses the same method as Experiment 1, but now the pronoun is in the main clause. This allows us to see if the processing bias found in Experiment 1 is strong enough to ignore or override syntactic factors, in particular, Binding Theory (cf. Kazanina and Phillips 2010, Clackson and Clahsen 2011). With the pronoun in the main clause, we can see if the parser is “impatient” enough to violate Binding Principle C, which states that R-expressions like names should be free. Thus, according to Principle C, in a sentence like (6b), “she” cannot refer to either Maria or Rita.

- (6) a. *Anaphora*: While Maria hugs Rita, she talks about the trip to Rome
 b. *Cataphora*: She talks about the trip to Rome, while Maria hugs Rita

3.2.1 Method, materials, participants

The materials and design were the same at Experiment 1. We used the same text items as in Experiment 1, except that we modified them so that the pronoun was now in the main clause, as in (7). Twenty-four native Italian speakers participated over the internet. None of them took part in Experiment 1.

- (7) a. SVO/null
Mentre Maria abbraccia Rita, ___ parla del viaggio a Londra
 while Maria hugs Rita, null speaks about-the trip to London
- b. null/SVO
 ___ parla del viaggio a Londra, mentre Maria abbraccia Rita
 null speaks about-the trip to London, while Maria hugs Rita
- c. SVO/overt
Mentre Maria abbraccia Rita, lei parla del viaggio a Londra
 while Maria hugs Rita, she speaks about-the trip to London
- d. overt/SVO
She parla del viaggio a Londra, Maria abbraccia Rita
 she speaks about-the trip to London, Maria hugs Rita
- (8) *Chi parla del viaggio a Londra?*
 Who talks about-the trip to London
- a. Maria
 b. Rita

- c. Qualcun altro (“someone else”)
- d. Entrambi/e (“could-be-either”)

3.2.2 Results

As can be seen in Figure 2, binding constraints are powerful enough to block the “impatient parser” processing bias observed in Experiment 1. In the cataphor conditions (null/SVO, overt/SVO), both null pronouns (92.7%) and overt pronouns (95.8%) overwhelmingly prefer “someone-else” (i.e., an extra-linguistic referent). This shows that participants obeyed Principle C, which prevents co-reference with the subject or object. The anaphor conditions (SVO/null, SVO/overt) pattern as one might expect given Experiment 1: null pronouns prefer subjects (79.1%), and overt pronouns prefer objects, though less strongly (61.4%).

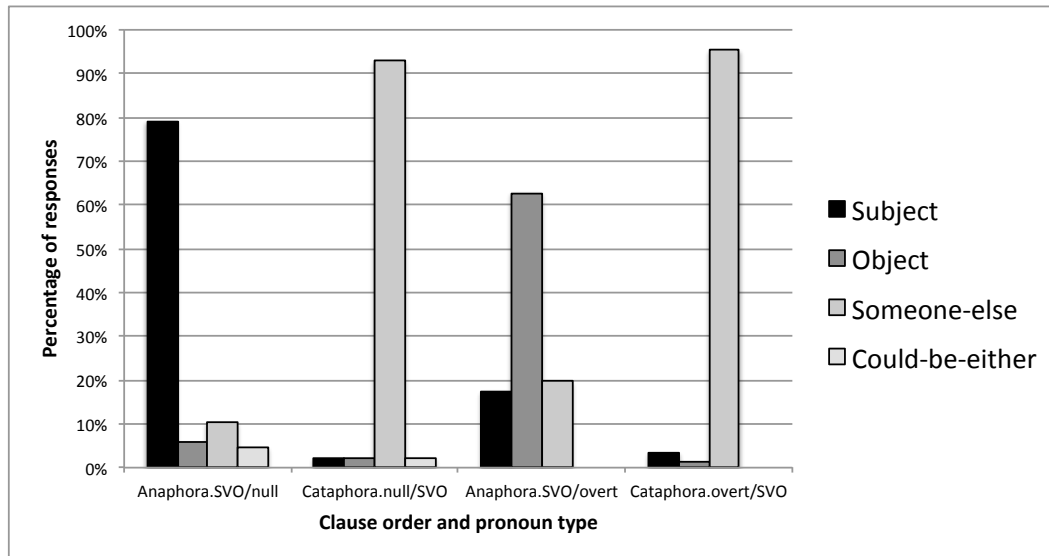


Figure 2: Antecedent choices for null and overt pronouns (pronoun in main clause).

The patterns visible in Figure 2 are supported by statistical analyses (reported briefly, for reasons of space): ANOVAs conducted on the proportion of “someone else” responses reveal significant main effects of clause order, main effects of pronoun form (significant by items, marginal by participants)³, but no interaction: Overall, with both overt and null pronouns, participants opt for “someone else” significantly more in the cataphor conditions than in the anaphor conditions, showing the effects of Principle C.³

ANOVAs conducted on the proportion of subject choices and object choices reveal significant ($p < .05$) main effects of clause order (anaphor vs. cataphor) and pronoun form (null vs. overt) and significant clause order X pronoun form interactions. When combined with the results of paired t-tests, these results show that in the anaphor conditions, overt pronouns have a significant object preference and null pronouns have a significant subject preference, which are absent in the cataphor conditions.

3.2.3 Discussion

In Experiment 2, with the pronoun in the main clause, we were able to test the strength of the “impatient parser” processing bias that we observed in Experiment 1: is this processing bias strong enough to ignore/override syntactic factors (cf. Kazanina and Phillips 2007), in particular Principle

³It seems that participants are somewhat more likely to choose a referent not mentioned in the sentence (“someone else”) with overt than null pronouns. This is not surprising, given that overt pronouns can refer to more “distant” referents whereas null pronouns normally refer to topical, local referents.

C of the Binding Theory? The short answer is, no. In Experiment 1, we saw that in the cataphor conditions, the parser tries to “discharge” an unresolved pronoun to the first encountered antecedent (subject). However, there is no evidence of this occurring in Experiment 2, where both forms show an equally-strong preference for “someone else” in the cataphor conditions. This suggests that Binding constraints are powerful enough to prevent effects of the “impatient” processing bias from surfacing in final interpretations

4 General Discussion

The current research investigated the anaphor/cataphor clause-order distinction in Italian, with two main aims. The first was to shed light on the interplay between processing biases (i.e., the active search mechanism) and linguistic, form-specific referential biases (i.e., preference for preceding subject vs. object). The second aim was to clarify the referential biases of null and overt pronouns.

Let us first consider how our results relate to the second aim. The results provide evidence that subject pronoun resolution in Italian does not follow a clear-cut division of labor based on syntactic structure, contrary to what one might expect in light of the Position of Antecedent Hypothesis (Carminati 2002). We do see in Experiments 1 and 2 that null and overt subject pronouns have different referential biases: overall, null pronouns prefer subject antecedents, and overt pronouns prefer non-subjects (in this case, object antecedents). This can be seen most clearly in the anaphoric configurations, where the pronoun comes after any possible antecedents. The anaphora results from both experiments show an overall preference for null and overt pronouns: null pronouns prefer the subject and the overt pronouns prefer the object. However, these patterns are best described as preferences; they were not absolute.

As regards to our first aim, investigating the interplay between processing biases and the referential preferences of different forms, our results show that reference resolution is guided both by processing constraints and the referential biases of different forms. The subject bias of null pronouns and the object bias of overt pronouns are modulated by the anaphor/cataphor distinction in a very particular way, which can be explained once we consider the processing biases created by the active search mechanisms that the parser engages in.

More specifically, Experiment 1 revealed an asymmetry between null and overt pronoun interpretation depending on clause-order: null pronouns had a clearer antecedent bias for the subject in the cataphor condition, while the overt pronoun had a clearer antecedent bias in the anaphor condition. In other words, the linear order of the encountered pronouns and constituents affects the interpretation of Italian null and overt pronouns. Cataphor conditions showed an overall strengthening of the subject preference, the first encountered antecedent in cataphora, for both null and overt pronouns.

Why should we see this strengthening of the subject bias in the cataphor conditions? Previous research suggests that when a parser encounters a cataphoric pronoun, it actively searches for an antecedent for the pronoun, excluding positions restricted by grammatical constraints (i.e., Principle C) (Cowart and Cairns 1987, van Gompel and Liversedge 2003, Kazanina, Lau, Lieberman, Yoshida and Phillips 2006). Under this view, the processor has an active processing mechanism that begins to construct referential dependencies as soon as an antecedent position can be reliably predicted, and strives to create a dependency as soon as it can, since keeping an unresolved pronoun in memory incurs a processing load.

Let us apply this to our sentences: In sentence-initial *while-clauses* containing cataphoric (null or overt) pronouns, the processor anticipates that the *while-clause* can be followed by a main clause containing a potential antecedent. Thus, encountering referential forms before potential antecedents (i.e., cataphora) induces an “impatient” processing bias to resolve the pronoun as referring to the earliest-encountered potential antecedent, in order to minimize the cognitive cost of maintaining an unresolved dependency. This fits with what we found: In the cataphor conditions of Experiment 1, there was less “competition” from the object antecedent for both null and overt pronouns (or, conversely, the object antecedent was considered more in the anaphor condition). This supports the idea that the “impatient parser” actively starts searching for a possible antecedent immediately upon encountering the null or overt pronoun. In the case of the null pronoun in cataphora, the first argument the parser encounters is the subject. Interpreting the null pronoun as referring to the subject is compatible with null pronouns’ subject preference, and so we see a

strengthening of the subject preference and a weakening of the object preference in cataphora.

If there is a cognitive cost to maintain an unresolved dependency, then for the overt pronoun there will be pressure on the processing system to connect the overt pronoun to the first argument it encounters (i.e., the subject), even if this conflicts with another constraint in the system, namely the preference that the overt pronouns have for objects, so the system is faced with a conflict. Therefore, we see a weakening of the object preference with overt pronouns in cataphora when the processing system “gives in” to the cognitive load and links the overt pronoun to the first argument it encounters (thus going against the basic preference that overt pronouns have for non-subjects).

Our results in Experiment 1 differ from Carminati (2002) and Serratrice (2007): We observed a clear bias for null pronouns to prefer subject antecedents and overt pronouns to prefer object antecedents. In particular, our finding that null pronouns in anaphoric configurations show a clear subject preference contrasts with Serratrice’s (2007) findings that the null pronoun did not have a strong antecedent bias in the anaphoric condition. Furthermore, we found that overt pronouns show more competition from subject and object antecedents in cataphora, contrasting with both Carminati (2002), whose findings reflect anaphoric configurations, and Serratrice (2007).

These discrepancies may be due to the differences in the test items, discussed previously: the test items used by Carminati (2002) and Serratrice (2007) varied verb tense and aspect, and used various connectives (e.g., “as soon as”, “when”, “after”). These properties of their stimuli are potentially important for pronoun interpretation because recent research has shown that the use and interpretation of pronouns depends on the semantic relation between the pronoun-containing clause and the antecedent-containing clause (e.g., Kehler 2002). For example, it has been shown that pronoun preferences are sensitive to verb tense and aspect (Rohde and Kehler 2008), and connectives carry extra focusing properties that may disrupt other preferences (Stevenson et al. 1994, 2000). This approach views pronoun resolution as a by-product of general inferencing and reasoning about relations between clauses (Hobbs 1979, Kehler 2002, Kehler, Rohde and Elman 2008). Therefore, the variability in the stimuli used by Carminati (2002) and Serratrice (2007) suggest that we may need to be careful when interpreting their results. The experiments reported in the present paper aimed to control for coherence effects by keeping the same connective and verb tense across items.

Finally, in line with related research (e.g., Kazanina and Phillips 2007), Experiment 2 found that strong grammatical principles (i.e., Binding Principle C) can “block” processing biases from affecting final interpretations. No “impatient parser” effect was found with cataphora in Experiment 2, contributing to our views of how processing biases and linguistic principles interact. Kazanina and Phillips (2010) found that in Russian, language-specific constraints and universal constraints restrict the possible antecedent pool in different ways: a language-specific constraint acts as a filter to possible antecedents, where a restricted antecedent is originally considered before ultimately being filtered out of consideration. However, a universal constraint, like Principle C, restricts entire structural domains from even being considered during the processing of cataphora clauses. In Experiment 2, we investigated a universal constraint, Principle C, and how this constraint could potentially interact with processing constraints, namely the “impatient parser” processing mechanism found in Experiment 1. We found that this processing constraint in Italian is not strong enough to block strong grammatical constraints.

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