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Disentangling Parsing and Grammar in Subject Pronouns Interpretation in Italian

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Abstract:

In the present study, we investigate if and how null and overt subject pronouns interpretation preferences in Italian can be influenced by two factors: (i) the presence of c-commanding antecedents (Rizzi 2018) and (ii) the 'impatient parser' (Sorace and Filiaci 2006; Fedele and Kaiser 2014). To disentangle the effects of c-commanding antecedents and of the 'impatient parser', we compare experimental conditions differing for only one of the two factors. The comparison demonstrates that c-commanding antecedents influence the interpretation of null pronouns but not the interpretation of overt pronouns, while no effect of the impatient parser is found for either null or overt pronouns. In addition, we found that external referent interpretation preferences are modulated by Principle C effects for null and overt pronouns, albeit to different degrees. External referent choices also increase when an overt pronoun is used as an emphatic pronoun.

Keywords: *C-command, Impatient Parser, Italian, Null Subject Pronouns, Overt Subject Pronouns*

1. Introduction

Null and overt subject pronouns in Italian have different antecedent biases. As proposed by Calabrese (1986), in a complex sentence like (1) the null pronoun (*pro*) in the main clause is interpreted as co-referent with the subject (*Carlo*) of the preceding temporal clause, while the overt pronoun (*lui*) is interpreted as co-referent with the object (*Antonio*) of the preceding temporal clause.

(1) Quando Carlo ha picchiato Antonio, *pro*/lui era ubriaco
'When Carlo hit Antonio, he was drunk'

Based on the results of a series of online and offline comprehension experiments, Carminati (2002) proposed that in Italian, a null pronoun is associated with an antecedent in a prominent syntactic position (Spec, IP), while an overt pronoun is interpreted in coreference to a lower and less prominent position (an hypothesis also known as the Position of Antecedent Hypothesis).[1]

In one experiment, Carminati (2002) created a sentence comprehension task including sentences like (2). After reading the sentence, participants had to choose one of two possible interpretations for the null/overt pronouns, as indicated in (3). The experimental sentences included a potentially ambiguous null/overt pronoun and consisted of a main clause where a subject (Marta) and an object antecedent (Piera) shared similar gender, followed by a temporal clause introduced by *quando* ('when').

(2) a. Marta scriveva frequentemente a Piera quando *pro* era negli Stati Uniti
b. Marta scriveva frequentemente a Piera quando lei era negli Stati Uniti
'Marta wrote to Piera often when *pro*/she was in the United States'

(3) a. Quando Marta era negli Stati Uniti
b. Quando Piera era negli Stati Uniti
'When Marta/Piera was in the United States'

The results of the sentence comprehension task showed an asymmetry between the interpretations of null and overt subject pronouns by Italian speakers, with a preference for selecting a subject antecedent in reference to a null pronoun (80.72%) and a preference for selecting an object antecedent in reference to an overt pronoun (83.33%). Carminati (2002) was the first study to show experimental evidence on the asymmetry in the interpretation of null and overt pronouns in Italian. Later studies have investigated this phenomenon, using different tasks and sentence materials.

For example, Sorace and Filiaci (2006) designed a Picture Verification Task to test the interpretation of anaphoric (4a, 4b) and cataphoric pronouns (4c, 4d). While anaphoric pronouns appear after the antecedents have been introduced, cataphoric pronouns precede the subject and object referents. In the task, participants could choose one of three pictures corresponding to different interpretations for the null/overt pronoun: the subject (*la mamma*), the object (*la figlia*) and an external referent (someone else not mentioned in the context).

		Subj	Obj	Ext
(4)	a. La mamma dà un bacio alla figlia mentre *pro* si mette il cappotto	0.51	0.44	0.05
	b. La mamma dà un bacio alla figlia mentre lei si mette il cappotto	0.08	0.82	0.11
	c. Mentre *pro* si mette il cappotto, la madre dà un bacio alla figlia	0.85	0.11	0.04
	d. Mentre lei si mette il cappotto, la madre dà un bacio alla figlia	0.12	0.24	0.64
	'The mother kisses the daughter while *pro*/ she is wearing her coat'			

Sorace and Filiaci (2006) found a clear subject bias for *pro* for sentences like (4c), where the null pronoun is cataphoric. However, differently from Carminati (2002), Sorace and Filiaci found a chance-level subject bias for *pro* in the anaphoric null pronoun condition in (4a).

[1] Differently from Carminati (2002), Calabrese (1986) proposed that the antecedent of *pro* is not simply a subject, but a 'subject of primary predication' or 'thema'.

It is not clear why in Sorace and Filiaci's study participants chose the subject interpretation more often for the cataphoric null pronoun (4c) than for the anaphoric null pronoun (4a). One possibility is that the different interpretations could be explained in terms of c-command. According to Rizzi (2018), the preference for interpreting a null pronoun as co-referent with a subject of predication antecedent (also called by Rizzi the "Calabrese effect") does not emerge if the null pronoun is c-commanded by the antecedents. For example, in (5), where *pro* is in a complement clause following the antecedents in the main embedding clause, the null pronoun is c-commanded by the antecedents. In this case, the Calabrese effect should not emerge, and *pro* can equally co-refer to a preceding subject or object DP (*Francesca* or *Maria*).

(5) Francesca ha fatto notare a Maria che *pro* era molto stanca
Francesca made Maria realize that *pro* was very tired

According to Rizzi (2018), in the absence of c-command, the 'Calabrese effect' should emerge, and pro is interpreted as co-referent with the subject antecedent, as illustrated in (1). In Sorace and Filiaci (2006), the antecedents in the main clause c-command the pronoun in the condition where the subject interpretation of pro is at chance (4a).[2] In contrast, in (4c), where the subject preference of the null pronoun is strong, the antecedents in the adjunct clause do not c-command the pronoun. Thus, the presence/absence of c-commanding antecedents could explain why Italian speakers have a strong preference for the subject when they interpret the null pronoun in (4c) compared to (4a).

Besides c-command, an additional factor that could play a role in Italian comprehenders' preferences is the linear position of the pronoun with respect to the antecedent (anaphora vs. cataphora). For example, Sorace and Filiaci (2006) suggested that, in the case of cataphora, the parser actively tries to complete the pronoun- antecedent dependency as soon as possible (as suggested for English by Cowart and Cairns 1987 and van Gompel and Liversedge 2003). Fedele and Kaiser (2014) proposed a similar argument based on the results of two comprehension experiments. In Experiment 1, Fedele and Kaiser presented a null/overt pronoun in an adjunct clause that could either precede (6a and 6c) or follow (6b and 6d) the main clause.

(6) a. Mentre *pro* parla del viaggio a Londra, Marta abbraccia Rita
b. Marta abbraccia Rita mentre *pro* parla del viaggio a Londra
c. Mentre lei parla del viaggio a Londra, Marta abbraccia Rita
d. Marta abbraccia Rita mentre lei parla del viaggio a Londra
'Marta hugs Rita while *pro*/she talks about the trip to London'

After reading a sentence, participants answered a comprehension question where they were required to interpret a potentially ambiguous pronoun, choosing between a subject antecedent, an object antecedent, an external referent and an 'either' option. Fedele and Kaiser's results revealed that the null pronoun was associated significantly more often with

[2] As observed by Pesetsky, an object placed in a main clause can bind inside a post-posed adjunct adverbial, as shown in (i), adapted from Pesetsky (1995: 161):

(i) Sue spoke to these people$_i$ about each other$_i$'s friends

The solution proposed by Pesetsky is a 'Cascade' structure.

an object antecedent in anaphora (6b) compared to cataphora (6a), while the subject choices for the null anaphoric and cataphoric pronoun were comparable. For the overt pronoun, Fedele and Kaiser found a significantly higher choice of object antecedent in the anaphoric pronoun condition (6d) and a higher choice of subject antecedent in the cataphoric pronoun condition (6c). The authors proposed that in the cataphoric pronoun condition, the 'impatient' parser strives to resolve the pronoun as soon as possible, associating the pronoun to the first antecedent that is encountered, i.e., the subject of the main clause. However, notice that, similarly to the experimental sentences in Sorace and Filiaci (2006), the a/c and the b/d conditions in (6) differ in terms of anaphora vs. cataphora, but also in terms of presence/absence of c-commanding antecedents.

In a second experiment, Fedele and Kaiser (2014) looked at the interpretation of null and overt pronouns in sentences like (7).

(7) a. Mentre Maria abbraccia Rita *pro* parla del viaggio a Londra.
b. Mentre Maria abbraccia Rita lei parla del viaggio a Londra.
c. *pro* parla del viaggio a Londra, mentre Maria abbraccia Rita.
d. Lei parla del viaggio a Londra, mentre Maria abbraccia Rita.

In (7c) and (7d), a cataphoric pronoun c-commands the antecedents, giving rise to higher external referent interpretations for both null and overt pronouns. Fedele and Kaiser concluded that in this case, Principle C effects override the impatient parser effect. Similarly to Fedele and Kaiser's Experiment 1 (and Sorace and Filiaci's), we note that (7a) - (7b) and (7c) - (7d) differ on: (i) the linear order of pronoun and antecedents and (ii) c-command (in this case c-command of the pronoun towards the antecedents).

In the present study, we propose that the existing experimental evidence confounded two separate factors: the 'impatient parser' and the presence/absence of c-commanding antecedents. We look at these two factors from the perspective of null and overt pronoun interpretation in Italian. In addition, in order to disentangle c-command of the pronoun and anaphora/cataphora, we created a sentence comprehension task where we manipulated bi-clausal sentences, obtaining eight conditions differing only for one of the above-mentioned factors (c-command; anaphora/cataphora; null/overt pronoun), as shown in Table 1.[3]

Condition	Example	Features
1	Giorgio ha visto Luigi quando *pro* stava andando al bar *Giorgio saw Luigi when (he) was going to the coffee shop*	+cc (A); an; null
2	Giorgio ha visto Luigi quando lui stava andando al bar	+cc (A); an; overt
3	Quando *pro* stava andando al bar, Giorgio ha visto Luigi	-cc; cat; null
4	Quando lui stava andando al bar, Giorgio ha visto Luigi	-cc; cat; overt
5	*pro* stava andando al bar, quando Giorgio ha visto Luigi	+cc (P); cat; null
6	Lui stava andando al bar, quando Giorgio ha visto Luigi	+cc (P); cat; overt

[3] The factors manipulated in the experimental design and included in the statistical analyses are: Type of pronoun (Null vs. Overt), Position of the antecedents (in main clause vs. in adjunct clause) and Pronoun position (anaphora vs. cataphora).

7	Quando Giorgio ha visto Luigi, *pro* stava andando al bar	-cc; an; null
8	Quando Giorgio ha visto Luigi, lui stava andando al bar	-cc; an; overt

Table 1. Examples of the eight experimental conditions

As illustrated in Table 1, in Condition 1 and 2, the antecedents c-command the pronoun ('+cc (A)') and they linearly precede it (anaphora, 'an'). In Condition 1, the pronoun is null, while in Condition 2 the pronoun is overt.

In Condition 3 and 4, the antecedents linearly follow the pronoun (cataphora, 'cat'). In these conditions, the antecedents do not c-command the pronoun, and the pronoun does not c-command the antecedents because it is located in the adjunct temporal clause ('-cc'). In Condition 3, the pronoun is null, while in Condition 4 the pronoun is overt.

In Condition 5 and 6, the antecedents linearly follow the pronoun (cataphora, 'cat') and they do not c-command the pronoun. However, the pronoun c-commands the antecedents ('+cc (P)') because it is located in the main clause. When a pronoun c-commands the antecedents, conference should be prevented by Principle C of the Binding Theory (Chomsky 1981). In Condition 5, the pronoun is null, while in Condition 6 the pronoun is overt.

In Condition 7 and Condition 8 the antecedents linearly precede the pronoun (anaphora, 'an') but they do not c-command the pronoun ('-cc') because they are located in the adjunct temporal clause. In Condition 7, the pronoun is null, while in Condition 8 the pronoun is overt.

Condition 1 and 7 (similarly to Condition 2 and 8) differ only on the presence/absence of c-commanding antecedents.

Condition 3 and 7 (similarly to Condition 4 and 8) differ only in terms of anaphora/cataphora. Condition 3 and 5 (similarly to Condition 4 and 6) include cataphoric pronouns. However, while in Condition 3 and 4 the pronoun does not c-command the antecedents, the pronoun c-commands the antecedents in Condition 5 and 6.

Using the set of sentences exemplified in Table 1, we investigate the role of the 'impatient parser' and of the presence/absence of c-commanding antecedents in the interpretation of subject pronouns in Italian addressing the following research questions:

RQ1: Is there an effect of c-commanding antecedents in the interpretation of subject pronouns in Italian? Is this effect the same for null and overt pronouns?

RQ2: Is there an 'impatient parser' effect in the interpretation of subject pronouns in Italian? Is this effect the same for null and overt pronouns?

RQ3: What drives external referent interpretations for null and overt pronouns?

2. The present study

2.1 Predictions

We predict that if the presence of c-commanding antecedents influences antecedent choices for the null pronoun, a preference for the subject antecedent (i.e. the 'Calabrese effect') should emerge more clearly in Condition 7 (where the antecedents do not c-command the pronoun)

than in Condition 1 (where the antecedents c-command the pronoun). The two conditions differ only on presence/absence of c-commanding antecedents: in both conditions, the antecedents linearly precede the pronoun (anaphora) and the pronoun is null. Similarly, when comparing the conditions including an overt pronoun and differing only for the presence/absence of c-commanding antecedents, we expect that a preference for the object antecedent should emerge more clearly in the absence of c-command (Condition 8 vs. Condition 2).

If the 'impatient parser' plays a role on antecedent choices in Italian, a preference for the subject antecedent (i.e., the first encountered antecedent) should be higher for both null and overt pronouns when the pronoun linearly precedes the antecedents (cataphora), compared to the cases where the pronoun follows the antecedents (anaphora). Thus, we expect that subject choices should increase in Condition 3 compared to 7, and in Condition 4 compared to 8. Notice that Condition 3 and 7 (similarly to Condition 4 and 8) differ only on the linear order of pronoun and antecedent (anaphora/cataphora), because the antecedents do not c-command the pronoun.

If Principle C effects contribute to increase participants' external referent preferences, we expect an increased number of external referent choices in (i) Condition 5 vs. 3, and (ii) Condition 6 vs. 4. This result is expected because contrary to Condition 3 and 4, in Condition 5 and 6 the pronoun precedes and c-commands the antecedents.

Finally, if null and overt pronouns have distinct and complementary antecedent biases, we should find a higher subject preference for the null pronoun and a higher object preference for the overt pronoun. If presence of c-commanding antecedents and 'impatient parser' effects influence comprehenders' interpretation, pronoun biases should be more clear-cut in anaphoric contexts and in the absence of c-commanding antecedents, i.e., in Condition 7 for the null pronoun and in Condition 8 for the overt pronoun.

2.2 Method

Sixty-two native speakers of Italian (age: 24.5; SD: 3; females: 42; males: 20) who were undergraduate and graduate students at the Università per Stranieri of Perugia, in Central Italy, volunteered to participate in the study.

We designed a comprehension task where participants read sentences and answered comprehension questions. The task consisted of thirty-two semantically neutral complex sentences, including a main clause and a temporal adjunct clause introduced by *when*. The experimental sentences included a subject (Giorgio) and an object antecedent (Luigi) that shared similar gender. In Italian, overt pronouns in the third person singular include gender information (*lui*=masculine; *lei*=feminine). Thus, gender similarity of the subject and object antecedent ensured ambiguity of the pronoun. Half of the experimental sentences contained proper names that are stereotypically masculine, and the other half contained proper names that are stereotypically feminine (e.g., Maria and Francesca).

Each sentence was manipulated to create eight conditions, as illustrated in Table 1. In half of the sentences, the main clause preceded the adjunct temporal clause (Condition 1, 2, 5, 6), and in the other half the main clause followed the adjunct temporal clause (Condition 3, 4, 7, 8). Half of the conditions included a null pronoun (Condition 1, 3, 5 and 7) and half included an explicit pronoun (Condition 2, 4, 6, 8). The pronoun either followed (Condition 1, 2, 5, 6) or preceded the antecedents (Condition 3, 4, 7, 8), creating four conditions with anaphora and four conditions with cataphora.

Participants were instructed to read each sentence and answer a three-choice comprehension question that tapped into the interpretation of the ambiguous pronoun. In the comprehension question, one answer corresponded to the subject referent (*Giorgio*), one to the object referent (*Luigi*) and one to an external referent not mentioned in the sentence (*Qualcun altro*), as shown in (8). The position of the subject, object and external referent in the three-choice comprehension question was counterbalanced across-items.

(8) Chi stava andando al bar?
Giorgio
Luigi
Qualcun altro
'Who was going to the coffee shop? a) Giorgio b) Luigi c) Someone else'

Participants were presented with instructions and two practice trials before starting the experiment. The experimental items were divided into eight lists and, using a Latin square design, each list contained four sentences per each condition.

Sixty-four filler sentences that did not include a null or overt subject pronoun were created. Conjunctions different from *when* were included in the filler sentences. Filler sentences contained either two, three or four characters of different gender. An example of a filler sentence and of the corresponding comprehension question are shown in (9) and (10).

(9) Renato e Giulia insegnavano alle superiori. Renato voleva lasciare il lavoro e trasferirsi all'estero.
'Renato and Giulia were High School teachers. Renato wanted to leave his job and move abroad'

(10) Chi voleva trasferirsi all'estero?
Renato
Giulia
Qualcun altro
'Who wanted to move abroad? a) Renato b) Giulia c) Someone else'

Participants completed the task either as an online survey or as a pen and paper survey. Participants who did not score 85% accuracy on filler sentences were discarded (three participants not included in the participants' group).

3. Results

In Table 2 and Figure 1, we report the results of the subject, object and external referent interpretations in the eight experimental conditions.

		SUBJECT	OBJECT	EXTERNAL
1	Giorgio ha visto Luigi quando *pro* stava andando al bar [+cc (A); an; null]	0.76	0.19	0.04
2	Giorgio ha visto Luigi quando lui stava andando al bar [+cc (A); an; overt]	0.19	0.79	0.02

3	Quando *pro* stava andando al bar, Giorgio ha visto Luigi [-cc; cat; null]	0.87	0.07	0.06
4	Quando lui stava andando al bar, Giorgio ha visto Luigi [-cc; cat; overt]	0.41	0.37	0.21
5	*pro* stava andando al bar, quando Giorgio ha visto Luigi [+cc (P); cat; null]	0.44	0.10	0.47
6	Lui stava andando al bar, quando Giorgio ha visto Luigi [+cc (P); cat; overt]	0.15	0.23	0.62
7	Quando Giorgio ha visto Luigi, *pro* stava andando al bar [-cc; an; null]	0.85	0.11	0.03
8	Quando Giorgio ha visto Luigi, lui stava andando al bar [-cc; an; overt]	0.22	0.72	0.06

Table 2. Subject, object and external referent interpretations in the experimental conditions

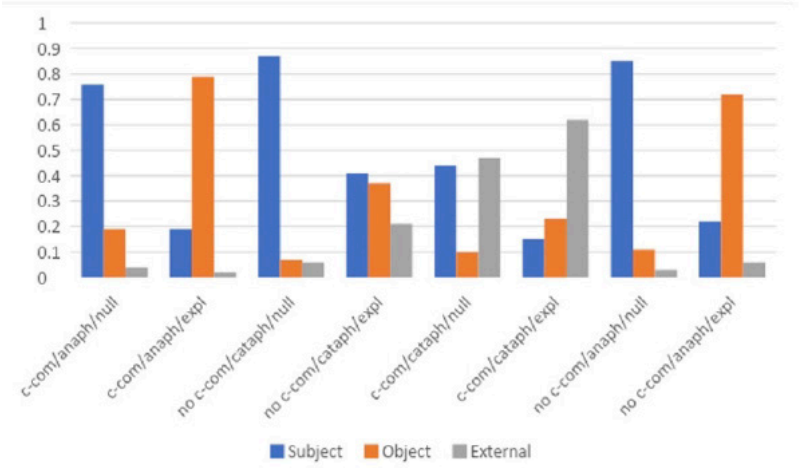

Figure 1. Subject, object and external referent interpretations in the different experimental conditions.

We used Logistic Mixed-effects Regression Modeling (LMER; Jaeger 2008) to analyze the number of subject, object and external referent interpretations (coded as 1 and 0) in three separate analyses, using the *glmer* function. The three models included the following factors: Type of pronoun (Null vs. Overt), Position of the antecedents (in main clause vs. in adjunct clause) and Pronoun position (anaphora vs. cataphora). All interactions were allowed. The model included the maximal converging random-effects structure allowed by the design (Barr *et al.* 2013). The full models are reported in the Appendix.

Each model revealed a significant Type of pronoun*Position of the antecedents*Pronoun position three-way interaction. We conducted planned comparisons to follow up on the three-way interaction using the Bonferroni correction. We only report the results relevant to our research questions.

Concerning the question about the presence/absence of c-commanding antecedents, a marginally significant difference (p=.07) emerged in the analysis of the subject interpretations for null pronouns in Condition 7 vs. 1. The effect suggests that participants chose a subject interpretation in Condition 7 (where the antecedents do not c-command the pronoun) more often than in Condition 1 (where the antecedents c-command the pronoun).

In the analysis of the object antecedent interpretations, no significant difference emerged for the comparison between Condition 1 and 7. However, we note a numerical trend indicating a higher number of object antecedent interpretations in the condition where the antecedents c-command the pronoun.

			Subj	Obj	Ext
(11)	1. Giorgio ha visto Luigi quando *pro* stava andando al bar	[+cc;an;null]	0.76	0.19	0.04
	7. Quando Giorgio ha visto Luigi, *pro* stava andando al bar	[-cc;an;null]	0.85	0.11	0.03
	(0.76/0.85, p=.07; 0.19/0.11, n.s.; 0.04/0.03, n.s.)				

For the overt pronoun, we found that the presence/absence of c-commanding antecedents does not significantly influence antecedent choices. The result emerged in the analysis of subject and object antecedent choices. Note that for the overt pronoun, we had predicted a difference in the opposite direction, i.e., higher object preferences in Condition 8 compared to 1.

			Subj	Obj	Ext
(12)	2. Giorgio ha visto Luigi quando lui stava andando al bar	[+cc;an;ov]	0.19	0.79	0.02
	8. Quando Giorgio ha visto Luigi lui stava andando al bar	[-cc;an;ov]	0.22	0.72	0.06
	(0.19/0.22, n.s.; 0.79/0.72, n.s.)				

Concerning the role of the 'impatient parser', we focus on the comparisons between conditions differing on the linear order of pronoun and antecedents, in the absence of c-command. While the model did not allow a statistical comparison, subject and object antecedent interpretations are numerically comparable for null and overt cataphoric and anaphoric pronouns. The numerical comparability suggests that the 'impatient parser' may not influence antecedent choices for the null pronoun, as shown in (13).

			Subj	Obj	Ext
(13)	3. Quando *pro* stava andando al bar, Giorgio ha visto Luigi	[-cc;cat;null]	0.87	0.07	0.06
	7. Quando Giorgio ha visto Luigi, *pro* stava andando al bar	[-cc;an;null]	0.85	0.11	0.03

For the overt pronoun, a numeric trend indicated a decrease in object antecedent interpretations for cataphoric pronouns (14). The decrease is associated with an increase in subject preferences and with an increase in external referent choices.

			Subj	Obj	Ext
(14)	4. Quando lui stava andando al bar, Giorgio ha visto Luigi	[-cc;cat;ov]	0.41	0.37	0.21
	8. Quando Giorgio ha visto Luigi, lui stava andando al bar	[-cc;an;ov]	0.22	0.72	0.06

If Principle C influences antecedent choices, external referent choices should increase in the conditions where the pronoun c-commands the antecedents (Condition 5 and 6) in comparison to the conditions differing only on this factor (Condition 3 and 4). This prediction is confirmed by the results found for null pronouns and overt pronouns, as shown in (15) and (16). The increase in external referent interpretations is associated with a decrease in subject interpretations for both null and overt pronouns.

		Subj	Obj	Ext
(15)	3. Quando *pro* stava andando al bar, Giorgio ha visto Luigi [-cc;cat;null]	0.87	0.07	0.06
	5. *pro* stava andando al bar, quando Giorgio ha visto Luigi [+cc;cat;null]	0.44	0.10	0.47
	(0.87/0.44, p<.0009; 0.07/0.10, n.s.; 0.06/0.47, p<.0001)			

		Subj	Obj	Ext
(16)	4. Quando lui stava andando al bar, Giorgio ha visto Luigi [-cc;cat;ov]	0.41	0.37	0.21
	6. Lui stava andando al bar, quando Giorgio ha visto Luigi [+cc;cat;ov]	0.15	0.23	0.62
	(0.41/0.15, p<.0001; 0.37/0.23, n.s.; 0.21/0.62, p<.0001)			

We now focus on the interpretation of null vs. overt pronouns. In Condition 7 and 8, the antecedents precede the pronoun and do not c-command it (17). In Condition 1 and 2, the antecedents precede and c-command the pronoun (18). The analyses demonstrated a significant difference in subject and object interpretations for anaphoric null vs. overt pronouns in both comparisons.

		Subj	Obj	Ext
(17)	7. Quando Giorgio ha visto Luigi, *pro* stava andando al bar [-cc;an;null]	0.85	0.11	0.03
	8. Quando Giorgio ha visto Luigi, lui stava andando al bar [-cc;an; ov]	0.22	0.72	0.06
	(0.85/0.22, p<.001; 0.11/0.72 p<.0001; 0.03/0.06, n. s.)			

		Subj	Obj	Ext
(18)	1. Giorgio ha visto Luigi quando *pro* stava andando al bar [+cc;an;null]	0.76	0.19	0.04
	2. Giorgio ha visto Luigi quando lui stava andando al bar [+cc;an;ov]	0.19	0.79	0.02
	(0.76/0.19, p<.001; 0.19/0.79, p<.001; 0.04/0.02, n. s.)			

In the conditions where the antecedents follow the pronoun (cataphora), a significant difference emerged in subject and object antecedent choices for null and overt pronouns, when the pronoun does not c-command the antecedents (Condition 3 and 4), and when the pronoun c-commands the antecedents (Condition 5 and 6).

		Subj	Obj	Ext
(19)	3. Quando *pro* stava andando al bar, Giorgio ha visto Luigi [-cc;cat;null]	0.87	0.07	0.06
	4. Quando lui stava andando al bar, Giorgio ha visto Luigi [-cc;cat;ov]	0.41	0.37	0.21

(0.87/0.41, p<.001; 0.07/0.37, p<.001; 0.06/0.21, p<.0001)

		Subj	Obj	Ext
(20)	5. *pro* stava andando al bar, quando Giorgio ha visto Luigi [+cc;cat;null]	0.44	0.10	0.47
	6. Lui stava andando al bar, quando Giorgio ha visto Luigi [+cc;cat;ov]	0.15	0.23	0.62

(0.44/0.15, p<.0001; 0.10/0.23, p<.0001; 0.47/0.62, p<.0001)

In addition, in the cataphoric contexts a significant increase in external referent preferences was found for null and overt pronouns when the pronoun c-commands the antecedents (20). The increase in external referent choices is significantly higher for overt pronouns than for null pronouns. For the overt pronoun, a significant increase in external referent preferences is found when the pronoun does not c-command the antecedents (19).

4. Discussion

In the present study, we conducted an offline sentence comprehension task where we tested the interpretation of null and explicit pronouns in Italian. We manipulated bi-clausal sentences to obtain eight conditions that differed in terms of (i) c-command (ii) anaphora/cataphora and (iii) null and overt pronouns.

The results confirmed that null and overt subject pronouns have clear antecedent biases in Italian. More specifically, comprehenders preferred to interpret null pronouns towards a subject antecedent and overt pronouns towards an object antecedent, as proposed by Calabrese (1986) and in line with previous experimental studies (e.g., Carminati 2002). In addition, our results show that these preferences can be influenced by several factors, but to a different degree for null and overt pronouns.

Concerning the role of c-command on the interpretation of null pronouns, our results showed that the subject preference for null pronouns is attenuated by the presence of c-commanding antecedents, as predicted by Rizzi (2018). The analysis demonstrated that comprehenders chose the subject antecedent interpretation for *pro* more often when the antecedents do not c-command the pronoun (Condition 7: 85%), compared to the condition where the antecedents c-command the pronoun (Condition 1: 76%). However, the difference is only marginally significant, suggesting that the effect of c-commanding antecedents is somewhat weak. A possibility is that Cascades, i.e., the kind of structure postulated by Pesetsky (1995) to explain binding of an object inside an adjunct clause, are not obligatory (but see Pesetsky 1995: 176-177).[4] In this case, c-command of both antecedents in Condition 1 and 2 may or may not occur. However, a strong subject bias of *pro* is observed beyond Condition 1. As indicated by the 44% subject choices in Condition 5 (Table 2), the subject bias of *pro* resists to a certain extent Principle C effects. Similarly, it could resist the effects of c-commanding antecedents in Condition 1.

Concerning Condition 1, we also note that the subject preference for *pro* is higher in our study than in Sorace and Filiaci (2006), where a similar context was tested and 51% of subject preferences were found (see Belletti *et al.* 2007 for similar results). The different result in our study may be due to the experimental techniques employed. While in our study

[4] We thank Marcel den Dikken for this suggestion. Future research should explore the effect of c-commanding antecedents in complex sentences containing an embedded clause instead of an adjunct clause. See Frascarelli (2018) for different results in main/embedded vs. main/adjunct syntactic contexts.

participants had to choose among written alternatives, in Sorace and Filiaci (2006), participants had to choose among different pictures. We hypothesize that a picture verification task may have prompted a deictic, rather than an anaphoric interpretation of pronouns, and we leave the issue open for future research. The results observed for Condition 1 are in line with Carminati (2002) and Fedele and Kaiser (2014), where a similar comprehension task was used as in the present study.

Concerning the role of the 'impatient parser', an 'impatient parser' effect did not emerge in our results for the interpretation of null pronouns. In the analyses, the subject antecedent interpretation for *pro* did not increase in cataphoric contexts, as predicted by the 'impatient parser' hypothesis (e.g., Fedele and Kaiser 2014). Relatedly, object antecedent choices did not decrease significantly when null pronouns were interpreted in cataphoric vs. anaphoric contexts (Condition 3 vs. 7, in (13) above).

Part of our research questions focus on the comparison between null and overt pronouns, to understand if similar processes influence the interpretation of both pronouns. Our results demonstrated that, for overt pronouns, the presence of c-commanding antecedents did not affect comprehenders' interpretation preferences, as shown by the lack of a significant effect in the comparison between Condition 2 and 8. Rizzi (2018) did not make predictions concerning the effect of c-command on overt pronouns, and our results suggest that the overt pronoun is interpreted preferably in conference with a non-subject antecedent regardless of the presence/absence of c-commanding antecedents.

We also found that the object preference for overt pronouns significantly decreased in Condition 4 compared to Condition 8. The two conditions differ only for the linear order of pronoun and antecedents (cataphora in 4, anaphora in 8). Nonetheless, we exclude an effect of 'impatient parser' for this comparison. On one hand, the decrease in object preferences is associated with an increase in subject interpretations as predicted by the 'impatient parser'. However, an increase in external referent interpretations is also observed, which is not predicted by the 'impatient parser'.

We propose that this result can be explained by assuming that the overt pronoun in Condition 4 is 'emphatic', i.e. it is used to introduce contrast or emphasis. As suggested by Calabrese (1986; see also Prentza and Tsimpli 2013), an emphatic pronoun is exempt from pronoun biases, so it can be interpreted towards a subject or an external referent.[5] In addition, the 'impatient parser' strategy was proposed to explain the processing of English overt pronouns, when comparing sentences including either a pronoun or a lexical DP, and not anaphoric vs. cataphoric pronouns (Cowart and Cairns 1987). [6] As such, it is possible that the 'impatient

[5] For example, in (i.a) there is no object antecedent, and the overt pronoun can have either a subject or an external referent interpretation:

a. Laura ha detto che lei non ha fame
b. Laura ha detto che *pro* non ha fame
'Laura said that (she) is not hungry'

The contrast/emphasis (Laura, differently from other people e.g. us, Giorgio…) is not entailed in (i.b) where the subject is a null pronoun. Emphatic uses of the overt pronoun, i.e. constructions like Condition 4, are often found in discourse sequences (e.g. Di Domenico and Matteini 2021).

[6] Cowart and Cairns (1987) used examples like (i):

a. While the boxes usually come with several internal partitions, packing cases …
b. While they usually come with several internal partitions, packing cases …

The ambiguous 'packing cases' was interpreted significantly more as a lexical noun phrase in (i.b) than in (i.a). The result was explained by the authors as a 'pronoun bias effect'. In addition, previous corpus research and experimental studies have demonstrated that differently from Italian, English overt pronouns have a strong subject bias (e.g., Michaelis and Francis 2007, Arnold *et al.* 2000).

parser' strategy may not apply to the anaphoric/cataphoric comparison that our study focused on (but see Sorace and Filiaci 2006; Fedele and Kaiser 2014, for a different interpretation).[7]

Our last research question focuses on the contexts that favor an external referent interpretation. Besides the results previously discussed, a significant increase in external referent interpretations was found when comparing Condition 6 and 4. In Condition 6, the overt pronoun precedes and c-commands the antecedents, while in Condition 4, the overt pronoun precedes but does not c-command the antecedents. Our results show that in Condition 6, Principle C blocked co reference of a lexical DP – an R expression in Chomsky (1981) – with a c-commanding constituent.

A similar result was found for the null pronoun in the matching conditions (5 vs. 3). However, in this case the increase in external referent interpretations is not as strong as for the overt pronoun condition, demonstrating that the subject bias for null pronouns remains relatively strong even in the presence of Principle C effects.

5. Conclusions

In the present study, we investigated if and how the interpretation of null and overt subject pronouns in Italian can be influenced by (i) the presence of c-commanding antecedents (Rizzi 2018) and (ii) the 'impatient parser' (Sorace and Filiaci 2006; Fedele and Kaiser 2014). To disentangle the effects of c-commanding antecedents and of the 'impatient parser', we compared experimental conditions differing only for one of these factors. The results of a sentence comprehension task revealed that c-commanding antecedents influence the interpretation of null pronouns but do not affect the interpretation of overt pronouns. In addition, we did not find evidence of an 'impatient parser' effect on the interpretation of either null or overt pronouns. External referent interpretations increased significantly when an overt pronoun was used as an emphatic pronoun or as an effect of Principle C. Finally, the increase of external referent interpretations due to Principle C effects emerged for overt pronouns more than for null pronouns.

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[7] An 'impatient parser' mechanism, furthermore, is incompatible with models based on an incremental interpretation process, such as Bianchi (2009). Following Williams (1997), Bianchi (2009: 8) assumes that a cataphoric ('backward' in her terms) pronoun implies an antecedent in the previous discourse, i.e. there is no real backward anaphora. This raises an interesting issue concerning how this antecedent is established in experimental settings like ours (or Sorace and Filiaci's, Fedele and Kaiser's), where there is no previous discourse. We leave the issue open for future research.

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Appendix

1. Full model effects: subject interpretations

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.08	0.17	-0.465	0.6
Type of pronoun	-2.80	0.13	-21.527	0.0001
Position of the antecedents	-0.58	0.13	-4.261	0.0001
Pronoun position	-0.14	0.11	-1.246	0.2
Type of pronoun*Position of the antecedents	0.19	0.23	0.821	0.4
Type of pronoun*Pronoun position	1.06	0.23	4.52	0.0001
Position of the antecedents*Pronoun position	-2.59	0.24	-10.742	0.0001
Type of pronoun*Position of the antecedents*Pronoun position	1.44	0.47	3.056	0.002

Note: The maximal random effect structure leading to convergence includes by subject and by item random intercepts and by subject and by item random slopes.

mod1 = glmer (NP1 ~ Type of pronoun*Position of the antecedents*Pronoun position + (1 | Item) + (1 | Subject), data = GD, family = 'binomial')

2. Full model effects: object interpretations

	Estimate	Std. Error	z value	p-value
(Intercept)	-1.0894	0.1245	-8.752	0.0001
Type of pronoun	2.4939	0.1347	18.515	0.0001
Position of the antecedents	-0.3321	0.1472	-2.257	0.02
Pronoun position	-1.5113	0.1307	-11.561	0.0001
Type of pronoun*Position of the antecedents	-0.4276	0.2582	-1.656	0.09
Type of pronoun*Pronoun position	-1.5355	0.2591	-5.926	0.0001
Position of the antecedents*Pronoun position	0.3647	0.2567	1.421	0.1
Type of pronoun*Position of the antecedents*Pronoun position	-1.4665	0.5132	-2.857	0.004

Note: The maximal random effect structure leading to convergence includes by subject random intercepts and by subject random slopes

mod2 = glmer (NP2 ~ Type of pronoun*Position of the antecedents*Pronoun position + (1 | Subject), data = GD, family = 'binomial')

3. Full model effects: external referent interpretations

	Estimate	Std. Error	z value	p-value
(Intercept)	-2.8914	0.2883	-10.031	< 2e-16
Type of pronoun	0.6191	0.2108	2.937	0.003
Position of the antecedents	1.3556	0.2468	5.493	0.0001
Pronoun position	3.0295	0.2286	13.25	0.0001
Type of pronoun*Position of the antecedents	0.3211	0.4157	0.772	0.4
Type of pronoun*Pronoun position	1.6106	0.4209	3.826	0.0001
Position of the antecedents*Pronoun position	2.5791	0.4316	5.976	0.0001
Type of pronoun*Position of the antecedents*Pronoun position	-2.5834	0.8353	-3.093	0.001

Note: The maximal random effect structure leading to convergence includes by subject and by item random intercepts and by subject and by item random slopes.

modExt = glmer (External ~ Type of pronoun*Position of the antecedents*Pronoun position + (1 | Item) + (1 | Subject) , data = GD, family = 'binomial')