A distinction among Φ-features: The role of gender and number in the retrieval of pronoun antecedents

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We investigated the use of two Φ-features, gender and number, in pronoun antecedent identification in six experiments in Italian.

In a previous work (Di Domenico & De Vincenzi 1996) we found that 1000 msec after the presentation of a pronoun only number information is used to restrict the set of possible antecedents for the pronoun, whereas gender information is not. Here we add two experiments with onset of the target word at 500 msec, which show that neither number nor gender are used.

The conclusion is thus that while number information is used within 500 and 1000 msec to restrict the reactivation of pronoun antecedents, gender is not.

The results are compared to previous experiments conducted in English by Nicol (1988). The author found an immediate use of number information but a less clear result for gender, possibly due to the fact that in English gender is not marked on the same way as number is.

Our study in Italian, with nouns where gender and number are equally overtly and regularly marked, suggests that the different use of gender and number is not specific to English nor has to do with the surface markedness of features, but, on the contrary, is to be attributed to an intrinsic difference between the two features.

This difference is characterized in terms of a different syntactic representation of the two features, as assumed in recent proposals in linguistic theory, and of the parser's modular use of linguistic information.*

1. Introduction

Interpretation of pronouns is a process that requires the identification of their correct antecedents. In their anaphoric use, pronouns are semantically empty elements "bound" to other elements with which they corefer. The identification of the intended antecedent of a pronoun is thus a central process in sentence comprehension achieved through the use of rules at various levels.

For example, a syntactic rule (Principle B of the Binding Theory (Chomsk 1981)) states that a pronoun cannot be interpreted as coreferent with a referential expression contained in the same governing category, explaining the contrast in (1) and (2):[1]

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(1) Carla loves her.
'Carla la ama (ama lei)'.

(2) Carla said that Maria loves her.
'Carla ha detto che Maria la ama (ama lei)'.

In (1) *Carla* cannot be interpreted as coreferential with *her* because *Carla* and *her* (the clitic pronoun *la* or the non-clitic *lei* in Italian) are in the same clause, while in (2) this coreference is possible since the two belong to different clauses.

On the contrary, a reflexive pronoun must have an antecedent in its governing category (Principle A of the Binding Theory). So in (3) the antecedent of the pronoun *herself* (the clitic *si* or the non-clitic *se stessa* in Italian) can only be *Maria*:

(3) Carla said that Maria loves herself.
'Carla ha detto che Maria si ama (ama se stessa)'.

A pronoun must also agree with its antecedent in the relevant morphological features, i.e. gender and number.

(4) Carla said that Maria loves them.
'Carla ha detto che Maria le ama (ama loro)'.

In (4), *Carla* and *them* (the clitic *le* or the non-clitic *loro* in Italian) cannot corefer because they mismatch in number.

There are also semantic and pragmatic constraints affecting pronouns antecedent identification. Consider (5):

(5) The boy told the doctor that the lady was waiting for him to get the prescription.

In (5) both *the boy* and *the doctor* are possible antecedents for *him* since they both belong to a different clause with respect to the pronoun, and they match the pronoun in gender and number. However, only *the doctor* is the intended antecedent, since world-knowledge tells that only doctors give prescriptions.

All these types of information must be used in the comprehension process to identify the intended antecedent. An interesting question is when these different types of information (syntactic, morphological, pragmatic) are used in coreference processing. We can make three different hypotheses based on this question:

i) only the correct antecedent is immediately reactivated;

ii) all antecedents (grammatical and ungrammatical, plausible and implausible) are initially reactivated and subsequently other types of information are used to select the appropriate one;

iii) only the grammatically correct antecedents are reactivated, and subsequently other types of information (such as semantic and pragmatic) are used to select the appropriate one.

The experimental evidence seems to favour the third hypothesis.

Corbett and Chang (1983) studied the use of pragmatic information. In their experiment, participants were presented with written sentences immediately followed by a probe word, i.e. a word which participants had to decide whether or ot it was in the sentence they had just read. The following are sample sentences:

(6) a. Ellen aimed a pistol at Harriet but Ellen did not pull the trigger.
b. Ellen aimed a pistol at Harriet but she did not pull the trigger.

The probe could be *Harriet* or *Ellen*. With sentences like (6a), recognition time was faster when the probe was *Ellen*. However, in sentences containing a pronoun like (6b) there was no significant difference in recognition time for the two probes. The results seem to show that in the case of the full noun (6a), only one antecedent, Ellen, is active in memory (and thus the matching probe is recognized faster), while in the case of the pronoun (6b) both antecedents (*Ellen* and *Harriet*) are active in memory. Given that our knowledge of the world tells us that the person who is handling the pistol is the one who can pull the trigger, and that ultimately we have no doubt in identifying in *Ellen* the intended antecedent for *she*, we are forced to conclude that there is a stage in which world-knowledge information is not used in pronoun antecedent retrieval.

What happens with syntactic information? Is every kind of antecedent reactivated (hypothesis (ii)) or only the grammatical ones (hypothesis (iii))?

Nicol (1988) collected experimental evidence that antecedents are retrieved according to syntactic principles. Using a cross-modal priming technique, she found that in sentences like (7), only the syntactically correct antecedents *landlord* and *janitor* were reactivated.

(7) The landlord told the janitor that the fireman with the gas-mask would protect him if it became necessary.

(8) The landlord told the janitor that the fireman with the gas-mask would protect himself if it became necessary.

When the pronoun of the embedded clause was a reflexive, as shown in (8), the opposite pattern emerged: only *fireman* (and neither *landlord* nor *janitor*) was reactivated, showing that the principles of Binding Theory are initially used to retrieve pronoun antecedents. Clifton et al. (this volume) offer more recent evidence in this direction and a deeper consideration of the problem.

An interesting question is when morphological information, such as number and gender, is used: is it used in the first stage together with syntactic information or is it used later?

We know that a pronoun must agree in gender and number with its antecedent, and it is clear that it would be an economical procedure for the parser to use this kind of information as soon as possible. A series of experiments conducted in English by Nicol (1988) show an interesting dissociation between the two features: while number information caused an immediate reactivation of the matching antecedent, gender information did not.

The experiments used pairs of sentences that were identical except for the anaphoric element, as shown in (9) and (10). The pronoun was either singular or plural and the sentences contained two preceding referents (*landlord* and *janitors* in (9) and (10)) which differed in number. Immediately after the pronoun, subjects were visually presented a target word for lexical decision. The target could be semantically related or unrelated to the antecedent which matches number with the pronoun:

(9) The landlord told the janitors that the fireman with the gas-mask would protect him [RENT/HERD] from getting hurt.

(10) The landlord told the janitors that the fireman with the gas-mask would protect them [CLEAN/SCORE] from getting hurt.

The prediction was that if number information is used at an early stage, then only the referent with the same number specification of the pronoun would be reactivated. The results confirmed the prediction: there was a significant priming effect when the antecedent and the pronoun were congruent and this was true for both singular and plural pronouns.

Appropriately modifying material like that presented in (9) and (10), Nicol (1988) also addressed the use of gender information. The sentences were like:

(11) The ballerina told the skier that the doctor would blame him for the injury.

(12) The ballerina told the skier that the doctor would blame her for the injury.

The results of the gender study are less clear. They showed a facilitation effect, but only in sentences like (11), i.e. when the pronoun was masculine: after *him* only *skier* (but not *ballerina*) was active, but after *her* both *ballerina* and *skier* were active.

A possible explanation (see also Nicol and O'Donnell, this volume) is that pronoun resolution processes consider all NPs that do not mismatch the pronoun: *ballerina*, which is female, mismatches the masculine pronoun, but *skier*, which is gender-neutral, does not mismatch the pronoun. If the gender study had contained only gender-specific nouns, the same pattern of results would have been observed for the gender and number study.[2]

Number and gender, in fact, have a different status in English, because gender, contrary to number, is generally not overtly marked on nouns, or is more marked on feminine nouns while masculine nouns tend to be neutral, and is not involved in agreement. Pronouns are the only lexical category clearly specified for gender in English and many scholars consider English a language without gender (see Corbett (1991) among others). This different status of the two types of information may account for their different use in the task we are dealing with.

But there is also an alternative, more general, hypothesis to explain the results: there can be an intrinsic difference in number and gender information, regardless of whether they are marked or not, used or not in agreement, in a particular language.

The two hypotheses clearly make two different predictions: according to the first hypothesis, if you replicate the experiment in a language with a clear and overtly marked gender, you should get results different from English, specifically the same pattern of results for gender and number.

According to the second hypothesis the results should replicate the English ones, that is, regardless of overtly marked gender, the use of gender information should not be available at the same point as the number information.

To test the two hypotheses, we ran parallel experiments in Italian, a language where gender is used in agreement and is overtly and regularly marked on nouns (as number is). If the results showed

a similar use of gender and number information in selecting pronoun antecedent, the difference found in English would be shown to be language specific. If instead the Italian data replicated the English ones, namely that number information was accessed at an earlier point than gender information, then it would be evidence in favour of the second hypothesis.

In what follows, after a brief sketch of gender and number in Italian (Section 2), we shall present and discuss six Italian experiments which study the use of gender and number information in pronoun antecedent resolution (Section 3, 4, 5). The four initial experiments used full pronouns, while the last two used clitic pronouns. Section 6 presents a linguistic explanation of the data, which is also confirmed by independent psycholinguistic evidence. In Section 7 some general conclusions are drawn.

2. *Gender and number in Italian*

Italian distinguishes two genders (masculine and feminine) and two numbers (singular and plural). Nouns, pronouns, adjectives, and determiners can be inflected for gender and number, while only number takes part in subject-verb agreement:

(13) a. Il ragazzo alto dormiva
TheM.SG boyM.SG tallM.SG sleepIMPF.3S
'The tall boy was sleeping'

b. La ragazza alta dormiva
TheF.SG girlF.SG tallF.SG sleepIMPF.3S
'The tall girl was sleeping'

c. I ragazzi alti dormivano
TheM.PL boyM.PL tallM.PL sleepIMPF.3P
'The tall boys were sleeping'.

As (13a) and (13b) show, the verbal suffix is identical in the case of masculine and feminine subjects, while it changes in the case of plural subjects (13c). Noun, determiner and adjective, on the contrary, are inflected for both gender and number.

As far as nouns are concerned, most animate nouns have a gender counterpart (i.e. a word with the same phonological, semantic, morphological and syntactic characteristics but differing in gender), which generally lacks in inanimate nous. Nearly all nouns have number counterparts.[3]

This differentiation sometimes is not indicated in the noun itself, but it is always indicated through the determine:

(14) a. il ragazzo / la ragazza / i ragazzi / le ragazze
theM.SG boy theF.SG girl theM.PL boys theF.PL girls

b. il cantante / la cantante / i cantanti / le cantanti
theM.SG singer/ theF.SG singer /theM.PL singers/ theF.PL singers

c. La città / *il citta / le citta / *i città
theF.SG city theM.SG city theF.PL cities theM.PL citiy

d. la diga/ *il diga/-o / le dighe /* i dighe/-i
theF.SG dam/ theM.SG dam/ theF.PL dams/ theM.PL dams

The nouns in (14a) and (14b) have variable gender and number. However, only in the case of (14a) gender variation is morphologically marked on the noun. The ending of (14b), on the contrary, is **-e** in the singular and **-i** in the plural, both in the feminine and in the masculine form. Gender variation is in this case signaled by the determiner that precedes the noun.

(14c) shows a noun with invariable gender and a variable number which is not morphologically marked. The noun, which is feminine, has no masculine counterpart, as shown by the stars, and has always the same ending (**-à**) in the singular and in the plural, and the difference in number is visible through the determiner. The noun in (14d) is again with invariable gender and variable number. In this case, however, number variation is indicated also in the noun.

The inflectional class the noun belongs to is thus responsible for the morphonological visibility of feature variation, which is in turn an independent factor: a noun can have variable or invariable gender, but if its gender is variable, not always this variation will be signaled morphologically on the noun itself. Number variation, as well, can be signaled or not, as the difference between (14c) and (14d) shows. Conversely, even if the inflectional class allows variation to be marked, it is not certain that there will be variation: the noun may have an invariable feature, as in (14d), whose gender is invariable. Most nouns belong to the same inflectional class as (14a), which has four distinct endings:

-o for masculine singular
-a for feminine singular
-i for masculine plural
-e for feminine plural

There is a limited group of masculine nouns ending in **-a** (such as *poeta*, 'poet') and of feminine nouns ending in **-o** (such as *mano*, 'hand'). When a counterpart exists, however, it is never marked with **-o** for feminine and **-a** for masculine, similarly to what is described for Spanish by Harris (1991): thus, *poeta* has a feminine counterpart which is *poetessa*.

Many nouns are like (14b): they have an ending in **-e** for the singular and **-i** for the plural irrespective of whether they are masculine or feminine.

The inflectional paradigm is complicated by other irregular forms, and by other subclasses. Some nouns, for instance, have a singular form **-a** and a plural in **-i** if they are masculine or in **-e** if they are feminine: this is the case of *il/la regista* (theM/F film director)- *le registe / i registi*.

There are also some gender-neutral nouns: il *gorilla* or *la guardia* can have both a masculine and a feminine referent.

From such a variety of situations, we have chosen, for our experimental material, only nouns with animate referents of the most productive inflectional class, as will be described in Section 3. These nouns always have a gender counterpart as well as a number counterpart, which are overtly marked.

3. Number Experiments, Non-clitic pronoun

Two experiments were run to test the use of number information in pronoun antecedent identification. The two experiments differed only in the onset of the target word: 500 msec (Experiment 1) or 1000 msec (Experiment 2) after the pronoun.

3.1. Experiment 1

3.1.1. Method

PARTICIPANTS

Twenty students were paid L. 10.000 ($7) each to participate to the experiment. All participants were native speakers of Italian and were not aware of the purpose of the experiment.

MATERIALS

Each experiment used 32 pairs of sentences. The pairs of sentences were identical except for the anaphoric element. All sentences contained two antecedents outside the local domain of the pronoun which were of the same gender, but differed in number. All the antecedents were nouns with human referents, with natural variable gender, morphologically marked and following the more productive inflectional class (*o/i* for masculine, *a/e* for feminine). In half of the cases the anaphoric element was a singular pronoun, in the other half a plural pronoun, as exemplified in (15) and (16) respectively.

The choice of the associate target words was done through a norming study. We gave 25 participants, native speakers of Italian, the list of nouns to be used in the experiment and asked them to indicate the first two words that came to mind in association with any given item. We chose for each noun the word that was most often associated with it. The matched control target word was then selected taking a word that was unrelated in meaning with any word in the sentence, and was matched for length in letters and frequency (as determined by the Bortolini *et al.* (1971) norms).

Given that length and frequency are the major determinant of reaction time in a lexical decision task and that the associate target and its control were matched on both dimensions, any difference in reaction time between associate and control targets should give a measure of priming, i.e. facilitation of the response to an item. In other words, if subjects are faster in their lexical decision time in condition (a), where the word is a semantic associate of the antecedent of the pronoun, than in condition (b), then this difference could be taken as evidence of reactivation of the antecedent of the pronoun. However, further controls are needed to assess whether priming really occurs, in that, as pointed out by McKoon and Ratcliff (1994), McKoon *et al.* (1994) and by Nicol *et al.* (1994), it might be that a related target is recognized faster because it is generally associated with the meaning of the sentence or because the original activation of the antecedent has not completely decayed by the time the pronoun is processed. To control for this possibility, we compared the related/unrelated conditions across sentences, in particular in a sentence context identical in all details except that the pronoun does not reactivate the antecedent associated with the related target. This corresponds to conditions (c) and (d). If the related / unrelated target difference is not present in the same sentence context when an incongruent pronoun is used, then it means that a difference between related / unrelated target in (a) and (b) is due to the reactivation of the antecedent, and not simply by general association of the related target with the sentence meaning or to residual activation of the antecedent. Summing up the experiment had four experimental conditions for each sentence, as exemplified in (15) and (16). The complete list of the materials is given in Appendix 1.

(15) a. CONGRUENT REFERENT, ASSOCIATE TARGET:
Lo sposo disse agli alunni che il vecchio generale in pensione voleva salutare lui [MATRIMONIO] quanto prima.
'The bridegroom told the pupils that the old retired general wanted to greet him [MARRIAGE] as soon as possible'.

b. CONGRUENT REFERENT, CONTROL TARGET:
Lo sposo disse agli alunni che il vecchio generale in pensione voleva salutare lui [POMERIGGIO] quanto prima.
'The bridegroom told the pupils that the old retired general wanted to greet him [AFTERNOON] as soon as possible'.

c. INCONGRUENT REFERENT, ASSOCIATE TARGET:
Lo sposo disse agli alunni che il vecchio generale in pensione voleva salutare loro [MATRIMONIO] quanto prima.
'The bridegroom told the pupils that the old retired general wanted to greet them [MARRIAGE] as soon as possible'.

d. INCONGRUENT REFERENT, CONTROL TARGET:
Lo sposo disse agli alunni che il vecchio generale in pensione voleva salutare loro [POMERIGGIO] quanto prima.
'The bridegroom told the pupils that the old retired general wanted to greet them [AFTERNOON] as soon as possible'.

(16) a. CONGRUENT REFERENT, ASSOCIATE TARGET:
Gli operai dissero al biologo che l'impiegato del centro stampa poteva intervistare loro [FABBRICA] solo fino alle cinque.
'The workers told the biologist that the employee of the news center could interview them [FACTORY] only until five'.

b. CONGRUENT REFERENT, CONTROL TARGET:
Gli operai dissero al biologo che l'impiegato del centro stampa poteva intervistare loro [PROCESSO] solo fino alle cinque.
'The workers told the biologist that the employee of the news center could interview them [TRIAL] only until five'.

c. INCONGRUENT REFERENT, ASSOCIATE TARGET:
Gli operai dissero al biologo che l'impiegato del centro stampa poteva intervistare lui [FABBRICA] solo fino alle cinque.
'The workers told the biologist that the employee of the news center could interview him [FACTORY] only until five'.

d. INCONGRUENT REFERENT, CONTROL TARGET:
Gli operai dissero al biologo che l'impiegato del centro stampa poteva intervistare lui [PROCESSO] solo fino alle cinque.
'The workers told the biologist that the employee of the news center could interview him [TRIAL] only until five'.

Within each sentence, the two antecedents had the same gender. The antecedent gender was balanced across items so that half of the sentences had feminine antecedents and half of them had masculine antecedents. The grammatical role of the antecedent was balanced across items, so that half of the sentences with the singular pronoun had the antecedent in subject position and the other half in object position and the same was true for the plural pronouns.

The materials also included 16 pseudoexperimental sentences, i.e. sentences with the same length and structure as the experimental sentences but with legal non-words as lexical decision targets. There were also 40 filler sentences, with random structure and length and with an equal number of words and non-words as lexical decision targets. Some sentences (22 out of 88) were followed by a comprehension question, to keep subjects alert to whole sentences. The design was a repeated measure, with a Latin square. Each subject was exposed to all conditions but did not see more than one version of each sentence. Order of presentation of the sentences was randomized for each subject.

PROCEDURE

The experiment used an all visual, on-line, lexical priming technique. This technique is similar to the cross modal one (Swinney *et al.* 1979).[4] The main difference is the modality of presentation of the text: subjects read the sentence instead of listening to it.

The sentences were presented word by word starting from the left edge of the screen. Each word was presented for 350 msec before the next word appeared, and then remained on the screen until the pronoun appeared. Then the whole sentence disappeared and the target word (for which a lexical decision had to be made) appeared in green capital letters, raised by one line, between asterisks. The target stayed on for 400 msec, then there was a 1000 msec blank.

Participants had to make a lexical decision pressing the keys WORD or NON-WORD. The program registered the answers to the lexical decision given within these 1400 msec. Then the sentence continued, in cumulative fashion, as it did before.

In order to track the timing of the reactivation of the antecedent we varied the onset of the target word. In the first experiment, the target word appeared 500 msec after the pronoun, in the second

experiment the target word appeared 1000 msec after the pronoun. Note that measuring reactivation at different points during the sentence is also a further control on the priming effect. If it can be shown that the related/unrelated target difference is present only after a certain delay following the appearance of the pronoun, then it can be safely excluded that the related/unrelated target difference is due to some general effect of association of the related target with the whole sentence meaning (cfr. McKoon *et al.* (1994) and Nicol *et al.* (1994)).

3.1.2. Prediction

The predictions are that if number information is used, then there should be shorter response time for the target related to the antecedent (condition a) than for the target unrelated to the antecedent (condition b). This difference, however, should not be present, or should be much smaller, when the pronoun is not congruent with the associate word (condition c and d). Therefore, if the pronoun antecedent is reactivated, we should find an interaction of target and congruence.

3.1.3. Results

The results are shown in Table 1. Participants whose mean for correct responses exceeded 1000 msec were excluded from the analyses. Two Anova's were conducted, one with subjects (F1), one with items (F2) as random variables. There were two variables with two levels each: Target (associate versus non-associate) and Congruence (matched or unmatched antecedent).

Table 1. Mean Response Time (in msec) to the Targets in the Different Conditions, Number Disambiguation, Experiment 1.

	Target Type	
	Associate	Control
Congruent Referent	661	672
Incongruent Referent	657	675

There was an effect of Target only by subject (F1 (1,19) = 5.38, MSe = 4566, $p < .03$, F2 (1,31) = .69, $p < .4$). No other main effect or interaction was significant.

DISCUSSION

The results show that 500 msec after the presentation of the pronoun no antecedent has been reactivated yet. The marginal hint of an effect of target suggests that words that are associate to some previous elements in the sentence are advantaged. Probably more time occurs before the pronoun is interpreted and its antecedent is reactivated in memory. The next experiment therefore replicates the first, increasing the delay between the presentation of the pronoun and the target onset to 1000 msec

3.2. Experiment 2

3.2.1. Method

Twenty-four students were paid L. 10.000 ($7) to participate to the experiment. All participants were native speakers of Italian and were not aware of the purpose of the experiment. None of them had participated to the previous experiment.

The same method and procedure was followed here as in Experiment 1, except that the delay between the presentation of the pronoun and the target onset was increased to 1000 msec. The predictions are the same as for Experiment 1.

3.2.2. Results

The results are shown in Table 2. Participants whose mean for correct responses exceeded 1000 msec were excluded from analysis. Two Anova's were conducted, one with subjects (F1), one with items (F2) as the random variables.

Table 2. Mean Response Time (in msec) to the Targets in the Different Conditions, Number Disambiguation, Experiment 2.

	Target Type	
	Associate	Control
Congruent Referent	723	762
Incongruent Referent	749	741

This time there was a significant interaction of target and congruence (F1 (1,23) = 5.31, MSe = 13744, $p < .03$, F2 (1,31) = 4.45, MSe = 20436, $p < .04$), indicating a difference in priming when the antecedent and the pronoun are either congruent or incongruent. No other main effects or interactions approached significance. Planned comparisons indicated that, when the antecedent and the pronoun are con-

gruent, participants responded more quickly to targets related to the antecedent than they did to control targets ($t1(23) = -2.46$, $p < .02$, $t2(31) = -2.19$, $p < .05$). The difference in responses to associates and controls did not differ in the incongruent conditions ($t(23) < .6$).

3.2.3. Discussion

The results of this experiment suggest that reactivation of antecedents is restricted by number information. In this respect the results confirm the data found in English by Nicol (1988). However further data are needed in order to see whether at this same point gender information is also used, or if the distinction found in English holds also in Italian.

The main difference between Nicol's results and ours is that while Nicol found reactivation immediately after the pronoun, we found it after a 1000 msec delay. We think that this difference is due to the methodology we employed, a visual-to-visual presentation, which most likely imposes a greater processing load.

In the cross-modal presentation, participants hear the sentence while they are fixing a point on the screen where the target word will appear. In this way, as soon as the target word appears, they can immediately start processing it in iconic memory, which, up to that point, has not been loaded by any other stimuli. In our experiment, in contrast, when the target word appears, following the other words of the sentence, participants have to fixate on it and then process it in the same sensory modality in which they have processed the previous words. It is therefore quite likely that there is a great load on the iconic memory and that this is reflected in longer times to process the target word.[5]

4. Gender Experiments

Two experiments were run to test the use of gender information in pronoun antecedents identification. As in the case of the number experiments, the two gender experiments differed only in the onset ofthe target word: 500 msec (Experiment 3) or 1000 msec (Experiment 4) after the pl onoun.

4.1. Experiment 3

4.1.1. Method

PARTICIPANTS

Twenty students were paid L. 10.000 ($7) to participate to the

experiment. All participants were native speakers of Italian and were not aware of the purpose of the experiment. None of the had partecipated in the previous experiments.

MATERIALS

The materials of the experiment was a modified version of that used in the number experiment.[6] The two antecedents had the same number but differed in gender, and the pronoun was either feminine or masculine. An example is given in (17). The complete list of the materials is in Appendix 2.

(17) a. congruent referent, associate target:
Lo zio disse alla laureanda che l'ingegnere conosciuto in vacanza poteva ricevere lei [TESI] certamente.
'The uncle told the doctorand(F) that the engeneer known during vacation could receive her [THESIS] in the afternoon'.

b. congruent referent, control target:
Lo zio disse alla laureanda che l'ingegnere conosciuto in vacanza poteva ricevere lei [NOCE] certamente.
'The uncle told the doctorand(F) that the engeneer known during vacation could receive her [WALLNUT] in the afternoon'.

c. incongruent referent, associate target:
Lo zio disse alla laureanda che l'ingegnere conosciuto in vacanza poteva ricevere lui [TESI] certamente.
'The uncle told the doctorand(F) that the engeneer known during vacation could receive her [THESIS] in the afternoon.

d. incongruent referent, control target:
Lo zio disse alla laureanda che l'ingegnere conosciuto in vacanza poteva ricevere lui [NOCE] certamente.
'The uncle told the doctorand(F) that the engeneer known during vacation could receive her [WALLNUT] in the afternoon.

The grammatical role of the antecedent was balanced across items so that half of the sentences had the antecedent in subject position and the other half in object position.

4.1.2. Predictions.

The prediction was that if gender information is used, then there should be shorter response time for the target related to the antecedent than for the target unrelated to the antecedent. This difference, however, should not be present, or should be much smaller, when the

pronoun is not congruent with the associate word. Therefore, if the pronoun antecedent is reactivated, we should find an interaction of target word and congruence.

4.1.3. Results.

The results are shown in Table 3. Participants whose mean for correct responses exceeded 1000 msec were excluded from the analyses. Two Anova's were conducted, one with subjects (F1), one with items (F2) as random variables. There were two variables with two levels each: Target (associate versus non-associate) and Congruence (matched or unmatched antecedent).

Table 3. Mean Response Time (in msec) to the Targets in the Different Conditions, Gender Disambiguation, Experiment 3.

	Target Type	
	Associate	Control
Congruent Referent	678	702
Incongruent Referent	661	697

There was an effect of target significance only by subject (F1 (1,19) = 6.30, MSe = 23290, $p < .02$, F2 (1,31) = 3.05, MSe = 20228, $p < .1$). No other main effect or interaction was significant.

4.1.4. Discussion

The results of the first experiment show that 500 msec after the presentation of the pronoun no antecedent has been reactivated yet. Again, the marginal hint of an effect of target may suggest that words that are associate to some previous elements in the sentence are advantaged. Probably more time occurs before the pronoun is interpreted and its antecedent is reactivated in memory: if gender information is used at the same time as number information, then we should find the priming effect at the same point where we found priming in the number disambiguation experiment, that is 1000 msec after the pronoun.

The next experiment therefore replicates the first, increasing the delay between the presentation of the pronoun and the presentation of the target to 1000 msec.

4.2. Experiment 4

4.2.1. Method

Twenty-four students were paid L. 10.000 ($7) to participate to the experiment. All participants were native speakers of Italian and were not aware of the purpose of the experiment. None of them had participated to the previous experiments. The material, procedure and predictions are the same as for Experiment 3.

4.2.2. Results

The results are shown in Table 4. Participants whose mean for correct responses exceeded 1000 msec were excluded from analysis. Two Anova's were conducted, one with subjects (F1), one with items (F2) as the random variables.

Table 4. Mean Response Time (in msec) to the Targets in the Different Conditions, Gender Disambiguation, Experiment 4.

	Target Type	
	Associate	Control
Congruent Referent	721	746
Incongruent Referent	731	745

There was an effect of Target, significance only by subject (F1 (1,23) = 7.09, MSe = 11098, $p < .02$, F2 (1,31) = 3.17, MSe = 20564, $p < .09$). No other main effect or interaction was significant.

4.2.3. Discussion

The results of this experiment show that gender information is not initially used by the coreference processor to select the appropriate antecedents, at least not at the same time as number information is used. The Italian data, therefore, support the distinction found in English in the use of number and gender information. However, given that Italian has also a series of clitic pronouns, we can further test the number-gender distinction using clitic pronouns.

5. Clitic Experiments

The following experiments test the use of number and gender

information using clitics, instead of full pronouns. As we have previously seen, the two series of pronouns do not differ with respect to syntactic and agreement constraints on coreference. Clitic pronouns share with the English pronoun the unstressed character. However, given that they always cliticize to the verb, they are perceptually less salient than a pronoun with a lexically independent form. For this reason, we changed the presentation rate from fixed to variable, according to word length: 50 msec per character, with a minimum of 250 millisecond.

In all other respects, the materials, presentation, procedure and methodology was the same as for the preceding experiments.

5.1. Experiment 5: Clitic pronoun and number information

5.1.1. Method

Twenty-eight students were paid L. 10.000 ($7) to participate to the experiment. All participants were native speakers of Italian and were not aware of the purpose of the experiment. None of them had participated to the previous experiments.

The same method and procedure is followed here as in Experiment 2: the delay between the presentation of the pronoun and the target onset was 1000 msec. The materials are the same as for the preceding number experiments (1 and 2), the only modification being the use of a clitic instead of a full pronoun. An example of the material is given in (18) and the complete list in Appendix 1.

(18) Lo sposo disse agli alunni che il vecchio generale in pensione voleva salutar-lo/li [MATRIMONIO/POMERIGGIO] quanto prima.
'The bridegroom told the pupils that the old retired general wanted to greet-him/them as soon as possible'.

The predictions are the same as for Experiment 1 and 2.

5.1.2. Results

The results are shown in Table 5. Participants whose mean for correct responses exceeded 1000 msec were excluded from analysis. Two Anova's were conducted, one with subjects (F1), one with items (F2) as the random variables.

Table 5. Mean Response Time (in msec) to the Targets in the Different Conditions, Clitic Pronoun, Number Disambiguation, Experiment 5.

	Target Type	
	Associate	Control
Congruent Referent	726	777
Incongruent Referent	769	771

There was a significant interaction of target and congruence ($F1\ (1,27) = 6.03$, $MSe = 15204$, $p < .02$, $F2\ (1,31) = 4.53$, $MSe = 23805$, $p < .04$), indicating a difference in priming when the antecedent and the pronoun were either congruent or incongruent. No other main effects or interactions approached significance. Planned comparisons indicated that, when the antecedent and the pronoun were congruent, participants responded more quickly to targets related to the antecedent than they did to control targets ($t1(27) = -3.79$, $p < .001$, $t2(31) = -3.54$, $p < .001$). The difference in responses to associates and controls did not differ in the incongruent conditions ($t(27) < .8$).

5.1.3. Discussion

The results of this experiment suggest that reactivation of antecedents is restricted by number information and that this result holds regardless of the clitic or non-clitic status of the pronoun.

5.2. Experiment 6: clitic pronoun and gender information

5.2.1. Method

Twenty-eight students were paid L. 10.000 ($7) to participate to the experiment. All participants were native speakers of Italian and were not aware of the purpose of the experiment. None of them had participated to the previous experiments.

The same method and procedure was followed as in preceding experiments: the delay between the presentation of the pronoun and the target onset was 1000 msec. The materials are the same as in the preceding gender experiments (3 and 4), the only modification being the use of a clitic instead of a full pronoun. An example of the materials is given in (19) and the complete list in Appendix 2.

(19) Lo zio disse alla laureanda che l'ingegnere conosciuto in vacanza poteva riceverla/-lo [TESI/NOCE] nel pomeriggio.
'The uncle told the doctorand that the engeneer known during vacation could receive-her/-him [THESIS/WALLNUT] in the afternoon'.

The predictions are the same as for Experiment 1 and 2.

5.2.2. Results

The results are shown in Table 6. Participants whose mean for correct responses exceeded 1000 msec were excluded from analysis. Two Anova's were conducted, one with subjects (F1), one with items (F2) as the random variables.

Table 6. Mean Response Time (in msec) to the Targets in the Different Conditions, Clitic Pronoun, Gender Disambiguation, Experiment 6.

	Target Type	
	Associate	Control
Congruent Referent	775	771
Incongruent Referent	767	780

There were no significant effects.

5.2.3. Discussion

The results of this experiment show that gender information is not initially used by the coreference processor to select the appropriate antecedents, at least not at the same time as number information is used. The results of these two last experiments with clitic pronouns therefore confirm the different use of number and gender information by the coreference processor.

This result does not mean, however, that gender information is not used at all in selecting the appropriate antecedent. Just and Carpenter (1977) have shown, for example, that the process of linking a pronoun to its antecedent can occur as soon as the pronoun is encountered or after the entire clause or sentence is read.

Gernsbacher (1989) tested reactivation of pronoun antecedents using gender disambiguation and a target recognition task (i.e.: was the target word in the sentence or not?). The mode of presentation of the sentence and target was all visual: Gernsbacher results show

reactivation effects at around 2000 msec after the presentation of the pronoun.

However, regardless of the exact timing at which number and gender informations are used by the parser, the interesting fact that emerges from the results of the number and gender studies, both in English and in Italian, is that pronoun antecedent identification is achieved sooner when cued by number information than when cued by gender information, and it is this fact that we should try to explain.

We can start considering that the distinction between number and gender information holds in English and Italian, regardless, therefore, of the fact that gender is marked differently in the two languages. The nouns that we used in the Italian experiments had the gender marked by a suffix and followed the more productive inflectional class: the marking of gender was therefore in all respect similar to that of number. If the use of morphological information is simply considered a matter of how this information is overtly and regularly marked, then there is no explanation for the difference found between number and gender, because in the Italian experiments the two features were marked exactly in the same way. It is clear, then, that the direction in which we should look is at what distinct levels of representation are the number and gender features relevant. Our hypothesis is that number information is relevant to the syntactic level of representation, while gender information is relevant to the lexical/semantic level of representation.

In the following section, we will present some independent psycholinguistic and linguistic evidence that support such a hypothesis and we will then show how, when such a hypothesis is coupled with a syntactic parsing model, the results we obtained are easily explainable.

6. A distinction among Φ-features

The Italian results and their comparisons to the English ones exclude the hypothesis that the number-gender difference is language specific. They instead support the hypothesis that there is an intrinsic difference between the two types of linguistic information.

Furthermore, the results show that in both languages there is a difference in the timing of the use of the two types of information: number information is used earlier than gender information. This difference in timing suggests that number information is used in ini-

tial parsing stages together with syntactic information, while gender information patterns more like lexical, semantic information.

In the linguistic literature, a distinction between the categories of number and gender is not new. Many authors have defined gender as a lexical, fixed property of words: Hockett (1958), for example, considers gender as a classification system for the nouns of a given language, while Greenberg (1978) defines gender as a fixed property of roots.

In the generative literature, some pre-minimalist accounts of gender and number have characterized their difference in terms of the grammatical component responsible for their assignment to nouns.

According to proposals stemming from Abney (1987), Noun Phrases are considered complements of a higher syntactic projection, the Determiner Phrase, and it is believed that between those two phrases, i.e. Determiner Phrase and Noun Phrase, there can be other functional heads (Picallo 1991; Cinque 1995; Ritteri 1988).[7] The fact that a certain feature is a syntactic head entails that it is represented independently in the lexicon and is then assigned syntactically to the noun through the movement of the noun itself into the head position corresponding to the feature in question.

Picallo (1991) claims that the DP in Romance includes a Gender Phrase as well as a Number Phrase.

Ritter (1988; 1993) assumes a (universal) DP structure which includes a NumP between DP and NP. According to this author, gender is syntactically expressed in NP in Semitic; in Romance, gender is assigned in NumP, together with number.

Harris (1991) assumes that gender is always assigned lexically.

Di Domenico (1995) proposes a (universal) differentiation of two types of gender (fixed and variable), one assigned lexically and expressed in the syntax under NP, the other assigned syntactically through movement of the noun to Num P.

Minimalism (see Chomsky 1995a) assumes that lexical items come out of the lexicon with their inflectional properties fully specified. Features are then checked syntactically through movement along functional heads. If features do not match, the derivation does not converge.

A minimalist account of the differences between gender and number, thus, cannot be maintained in terms of the syntactic component responsible for their assignment, because such a component is, according to this view, always the lexicon.

In minimalist terms, the difference between gender and number

can be restated in terms of their lexical and of their syntactic representation, as in Di Domenico (1997).

As far as lexical representation is concerned, developing a distinction proposed by Chomsky (1995a), Di Domenico (1997) proposes that number is to be considered a non-intrinsic, variable feature.[8]

The idea is that a feature can be represented independently in the lexicon only if it has semantic content, i.e. is [+Interpretable]; furthermore, in order to be varied, a feature must be non-intrinsic. Number is always interpretable, and is nearly always variable (see Section 2).

As far as gender is concerned, the idea is that there are two kinds of gender:

i) non-intrinsic gender, which is variable and necessarily [+Interpretable]
ii) intrinsic gender, which is invariable.

To illustrate the two kinds of gender, let us consider (20):

(20)

NOUN	Interpretability	Variability
a. ragazza 'girl'	+	+
b. donna 'woman'	+	–
c. sedia 'chair'	–	–

In (20) we have three nouns, all singular and feminine. The gender of these nouns differs with respect to the properties identified above. While the gender of (20a) is variable and interpretable, the gender of (20b) is interpretable but cannot be varied, and the gender of (20c) has no semantic content and cannot be varied. The number of all the three items, on the contrary, has semantic content and can always be varied:

(21)

	SingF	SingM	PlurF	PlurM
a.	ragazza	ragazzo	ragazze	ragazzi
b.	donna	*donno	donne	
c.	sedia	*sedio	sedie	

Thus the conclusion is that while nurnber is always a non-intrinsic, variable feature, only the gender of (20-21a) is non-intrinsic and variable. There is also a difference between the gender of (20-21b), which is interpretable, and the gender of (20-21c) which is not. The idea is that an interpretable feature *can* (not *must*) be non-intrinsic, but a non-interpretable feature must be intrinsic. There can

be many reasons why an interpretable feature is intrinsic: in the case of gender, as suggested by Di Domenico (1997) one reason can be eteronimy: if there is lexical counterpart for a noun, it will have a non-variable (i.e. intrinsic) gender, as in the case of (b), which has a lexical counterpart (*uomo*, 'man').

In order to provide a uniform format to lexical entries, and to capture the relation between interpretability of gender and animacy of the noun's referent, Di Domenico (1997) proposes that, in the lexicon, nouns either have an intrinsic specification of gender or are specified as [+Animate]. In this latter case, gender is assigned to them as they enter the numeration, a procedure assumed by Chomsky (1995a) for non-intrinsic features.

Some psycholinguistic evidence in favour of this characterization of gender and number can be found in a Spanish study on production errors (Garcia-Albea *et al.* 1989) that shows that in exchanges of noun roots it is the number suffix that gets stranded more often than the gender suffix.

The authors found that in cases where both number and gender differ, the stranding usually affects the number suffix, as in (22) (the correct form is given in square brackets):

(22) Un duro de veinte monedas
'A 'duro' M.SG worth twenty coinsF.PL
[Una moneda de veinte duros]
'[A coinF.SG worth twenty 'duros' M.PL]'

They found errors like those in (23) very rarely, where both gender and number get stranded:

(23) Hay medica de huelgos
'There is doctorF.SG of strikesM.PL'
[Hay huelga de médicos]
'[There is strikeF.SG of doctorsM.PL]'

Finally, Garcia-Albea *et al.* (1989) never found errors where only gender gets stranded. This study supports the idea that gender is more often an intrinsic feature and is thus attached to the root and tends to move along with it, whereas number is more likely to remain in place since it is independent from the root.

Igoa *et al.* (this volume) studied more carefully the cases of gender stranding. Interestingly they found that gender strandings are significantly more likely to occur with nouns like *el niño / la niña*

than with nouns like *el libro* which do not have a gender counterpart. These data support the idea that there is an intrinsic type gender (the one that cannot be stranded) and a non-intrinsic one, that can be stranded; finally, they show that nouns with animate referents have a non-intrinsic gender.

The other interesting fact reported in the two above mentioned studies is the fact that if there is gender stranding, it always goes along with number.

This seems to be correlated to the fact that gender, as assumed in many studies mentioned above, is not a syntactic head, a characteristic, as suggested by Di Domenico (1997), possibly connected to the fact that it is not always a variable feature independently represented in the lexicon.

One argument to think that gender is not a head can be taken from Cinque (1995). Cinque assumes that the position of adjectives in Germanic and Romance is the same and that the different superficial order that can be observed in (24) is due to noun movement to check Φ-features, which are strong in Romance and weak in Germanic:

(24) a. L'invasione italiana dell'Albania / * L'italiana invasione dell'Albania
b. The Italian invasion of Albania / * The invasion Italian of Albania

[Cinque 1995]

Cinque observes, however, that this movement is only one head higher rather than two, as it should be in order to check number and gender under distinct heads.

If gender is not a syntactic head, one can maintain that it is merged with number or with N. As already mentioned, proposals vary in this respect. Ritter (1993) suggests a cross linguistic difference (under N in Semitic, under Num in Romance); Di Domenico (1995) proposes that, universally, variable gender is under Num and fixed gender under N.

What is crucial to explain our data is that, as suggested by Di Domenico (1997), gender is a parasitic feature. This means that, in the syntax, it does not project, in the sense of Chomsky (1995b). If it does not project, it is not visible to the syntactic parser.

Number, on the contrary, is a syntactic head that projects in the syntax: it can host gender, but in any case it is the head and is thus visible to the syntactic parser. This idea can explain why gender is used by the parser later than number information (as shown by the

results of our experiments), given a modular theory of language processing.

In a modular theory of language usage, it is assumed that when people comprehend sentences, they initially build structural representations (cf. Kimball 1973; Frazier & Fodor 1978; Perfetti 1990; Rayner Carlson & Frazier 1983; De Vincenzi & Job 1995) using only the information that is relevant to that syntactic level of analysis, i.e. phrase-structure information. This means that at the initial syntactic parsing stage, only the features that project in the syntax will be computed. If only number, and not gender, heads a syntactic projection, only number information is available at this initial stage and thus could be used, for example, to establish a coreference between a noun and a pronoun.

The difference in timing in the use of number and gender information seems inconsistent with the class of interactive parsing models in which different sources of information, lexical, syntactic, semantic, pragmatic, communicate in an unconstrained fashion at the earliest stages of comprehension (Marslen-Wilson 1975; McClelland 1987; MacDonald *et al.* 1994). In such models there does not seem to be a natural explanation for the finding that two types of morphological information, which are overtly marked in the same way on nouns, are used at different times by the language processor. What these models would need in order to account for the English and Italian results are separate components for the assignment of structure at different levels of representation (syntactic, lexical, semantic) and an ordering of computation of the distinct levels of representation such that syntactic representation takes precedence over the assignment of other levels of representation.

7. *General conclusions*

The Italian experiments show that number information is used earlier than gender information in the retrieval of pronoun antecedents and this is true with different types of pronouns, such as clitics and non-clitics. These results are parallel to the English experiments conducted by Nicol (1988). The fact that there is no language specific difference suggests that the different use of the two kinds of information is not related to the way in which this information is superficially expressed. Other psycholinguistic data, like all the contributions in this volume, suggest that number and gender are used differently not only in comprehension but also in production.

The processing differences correspond to a linguistic difference among the two types of features. While number is to be considered a syntactic head, separately represented in the lexicon and with its own syntactic projection, this is not the case for gender, which is a parasitic feature in the syntax, i.e a feature that does not project.

Given a parsing model which initially computes a syntactic structure representation of a sentence, using only phrase structure information (Frazier 1985), the difference in timing in the use of number and gender information is easily explanable, given that only number is a syntactic head and therefore only number information will be readily available in the initial stage of syntactic parsing.

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NOTES

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1 *Binding Theory*:
(A) An anaphor is bound in its Governing Category
(B) A pronominal is free in its Governing Category
(C) An R-expression is free [Chomsky 1981: 188]
A main characteristic of the Italian pronominal system, as well as of the pronominal system of other Romance languages, is the presence of two series of pronouns: clitic and non-clitics (see e.g. Calabrese 1985). While clitic pronouns cannot occur independently in the speech chain and must always be attached to the verb, the non-clitic form can occur in the standard position of noun phrases. The two series behave identically with respect to the syntactic constraints on coreference considered here and therefore both forms will be indicated in the examples.

2 In this experiment, the male referents were generally unmarked and only a small portion were inherently male, such as "king", "butler" and "boy". The female referents were either inherently female such as "bride" and "queen", or overtly marked as feminine, such as "hostess".

3 A research on the basic lexicon of Italian (Di Domenico 1997) has shown that the 60.5% nouns with animate referent has variable gender. This percentage raises to 69.2% in the case of nouns with human referent. Nouns with inanimate

referents have variable gender only in 3.3% of the cases. Only 0.5% of nouns has invariable number.

[4] The priming technique has been shown to be reliably sensitive to the activation of word meanings. Furthermore it has the advantage of providing an on-line measure of activation that does not require an explicit check of memory prior to response, and it is relatively unintrusive on normal comprehension.

[5] Nicol (1993) compares the cross-modal and uni-modal priming technique. While for wh-traces she found immediate reactivation at the trace position, for pronouns she did not find an immediate antecedent reactivation. Her hypothesis is that visual presentation, compared to auditory presentation, makes it more difficult to remember the earlier material in a sentence, or that, alternatively, memory representation for auditorily presented words is stronger than for visually presented words. In either case, the interesting observation is that "visual presentation handicaps subjects just enough to show differences in how different types of dependencies are processed in wh-constructions, the wh-element is stored in a special memory buffer and it is readily retrieved at later points in a sentence. By contrast, nouns that are not so specially stored, may simply not be so readily accessible when a pronoun appears" (Nicol 1993). The comparison of cross-modal and uni-modal priming techniques seems therefore a promising way to study different types of dependencies.

[6] Some sentences had to be changed because the singular form of some nouns (which were used in the plural form in the number experiments) did not have a strong associate.

[7] The arguments used to postulate additional functional projections are usually the following: Under the assumption that a head can only move to another head position (Head Movement Constraint, Travis 1984), functional projections have been postulated to explain, for instance, the relative positions of nouns and adjectives in complex noun phrases. Along the same lines Ritter (1988) has proposed that number is the head of a functional projection, that she calls Number Phrase to explain the differences between the 'construct state' and the 'free genitive' constructions of Modern Hebrew.

[8] Chomsky (1995a) uses the term 'optional' instead of 'variable'. The latter seems preferable on the grounds that what is optional is not the feature itself but rather its value. See Di Domenico (1997).

APPENDIX 1

Materials for the number experiments.
Alternative conditions are separated by /: congruent condition first, then incongruent conditions.
Alternative pronouns are enclosed by |: non-clitic used in Experiment 1 & 2 first; then clitics used in Experiment 5.
Target words are in all capital letters within square brackets: associate word first, then control word.

1. Lo zio disse agli operai che la padrona di casa che guardava la televisione non poteva | sentire lui/loro | sentirlo/li | [PARENTE/PASCOLO] certamente.
2. Il sarto disse ai commessi che gli studenti venuti dalla Francia volevano |intervistare loro/lui | intervistarli/lo | [NEGOZIO/MATTINO] prima della partenza.

3. Il biologo disse ai guardiani che l'anziano parroco del paese vicino voleva conoscere lui/loro | conoscerlo/li | [SCIENZA/MISERIA] al più presto.
4. Mio cognato disse ai ladri che il giovane alla fermata dell'autobus non poteva | vedere loro/lui | vederli/lo | [GUARDIE/SCALINO] da lì.
5. Il filosofo disse ai cortigiani che il vicario, stanco del viaggio, non voleva | ricevere loro/lui | riceverli/lo | [CASTELLO/PETROLIO] per il momento.
6. Il postino disse ai pellegrini che la corista francese dai lunghi capelli biondi voleva | salutare lui/loro | salutarlo/li | [LETTERA/CAVALLO] prima di partire.
7. Mio cugino disse ai domestici che il nuovo segretario dell'associazione voleva | vedere loro/lui | vederli/lo | [CASA/ANNO] quel pomeriggio.
8. Lo sposo disse agli alunni che il vecchio generale in pensione voleva | salutare lui/loro | salutarlo/li | [MATRIMONIO/POMERIGGIO] quanto prima.
9. La cuoca disse alle laureande che il nuovo medico del distretto sanitario non poteva | visitare lei/loro | visitarla/le | [CUCINA/TITOLO] prima del 13 febbraio.
10. La maestra disse alle detenute che l'inserviente addetta al parlatorio non poteva vedere loro/lei | vederle/la | [CARCERE/LIVELLO] da quella posizione.
11. La segretaria disse alle fotografe che l'ingegnere della General Motors voleva | incontrare lei/loro | incontrarla/le | [UFFICIO/MERCATO] all'Harris Bar.
12. La contadina notò con le ragazze che il venditore di lupini non voleva mai | servire loro/lei | servirle/la | [AMORE/PUNTO] comé si deve.
13. Mia suocera notò con le novizie che il famoso cardiologo venuto da Parigi non poteva | ricevere loro/lei | riceverle/la | [SUORE/] in giornata.
14. Mia figlia osservò con le bidelle che la signora Brugnolini non poteva mai | ricevere lei/loro | riceverla/le | [PADRE/PAESE] dopo le 16.
15. La diva disse alle ballerine che il vigile ed il segretario comunale volevano | multare loro/lei | multarle/la | [DANZA/TOSSE] per eccesso di velocità.
16. La psicologa disse alle ragazze che l'insegnante di disegno voleva | vedere lei/loro | vederla/le | [LETTINO/FORMICA] durante la pausa.
17. I domestici dissero al neurologo che l'ultimo arrivato tra gli ospiti voleva | vedere lui/loro | vederlo/li | [CERVELLO/MEDAGLIA] immediatamente.
18. Gli alunni dissero al postino che il nuovo direttore certamente doveva | conoscere loro/lui | conoscerli/lo | [INSEGNANTE/SPETTACOLO] ormai abbastanza bene.
19. I cortigiani dissero al servo che il sacerdote più anziano voleva | vedere lui/loro vederlo/li | [SCHIAVO/MISTERO] l'indomani.
20. I pellegrini dissero allo sposo che il signore del villaggio voleva | rapire loro/lui | rapirli/lo | [VIAGGIO/INVERNO] per chiedere un riscatto.
21. I guardiani dissero a mio zio che il nuovo maestro elementare voleva | conoscere loro/lui | conoscerli/lo | [CANI/PACE] al più presto.
22. I ladri dissero al sarto che il padrone e il suo giovane aiutante potevano |raggiungere lui/loro | raggiungerlo/li | [AGO/OCA] da un momento all'altro.
23. Gli operai dissero al biologo che l'impiegato del centro stampa poteva |intervistare loro/lui | intervistarli/lo | [FABBRICA/PROCESSO] solo fino alle cinque.
24. I commessi dissero a mio cognato che il direttore del giornale pensava di

| raggiungere lui/loro | raggiungerlo/li | [FRATELLO/FINESTRA] con il primo volo l'ndomani.

25. Le novizie dissero alla diva che i parenti del giovane infortunato volevano | vedere lei/loro | vederla/le | [CINEMA/FRETTA] al più presto.
26. Le bidelle dissero all'impiegata che il direttore sarebbe stato contento di | consigliare loro/lei | consigliarle/la | [PULIZIE/DIGIUNO] per la dichiarazione dei redditi.
27. Le ballerine dissero a mia suocera che il regista e il produttore certamente volevano | scritturare lei/loro | scritturarla/le | [NUORA/TESTO] per il nuovo film.
28. Le bambine dissero alla psicologa che Claudio e Marco certamente dovevano | aspettare loro/lei | aspettarle/la | [GIOCHI/SBARCO] da un momento all'altro.
29. Le laureande confermarono alla segretaria che il Prof. Banfi voleva | vedere loro/lei | vederle/la | [TESI/NOCE] dopo lezione.
30. Le bambine dissero alla maestra che i ragazzi più grandi volevano passare a salutare lei/loro | salutarla/le | [SCUOLA/MINUTO] l'indomani.
31. Le fotografe dissero alla cuoca che il barista assunto il mese prima non voleva | aiutare loro/lei | aiutarle/la | [PAESAGGIO/GINOCCHIO] ad allestire il locale.
32. Le detenute dissero alla contadina che il nuovo direttore voleva | incontrare lei/loro | incontrarla/le | [CAMPO/CIELO] al più presto.

APPENDIX 2

Materials for the Gender Experiments.
Alternative conditions are separated by /: congruent condition first, then incongruent conditions.
Alternative pronouns are enclosed by |: non-clitic used in Experiment 3 & 4 first; then clitics used in Experiment 6.
Target words are in all capital letters within square brackets: associate word first, then control word.

1. Lo zio disse alla laureanda che l'ingegnere conosciuto in vacanza poteva | ricevere lei/lui | riceverla/lo | [TESI/NOCE] nel pomeriggio.
2. L'operaio disse alla cuoca che la padrona di casa che guardava la televisione non poteva | sentire lei/lui | sentirla/lo | [CUCINA/TITOLO] certamente.
3. Il domestico disse alla diva che l'oculista di cui avevano parlato poteva | ricevere lei/lui | riceverla/lo | [CINEMA/FRETTA] nel pomeriggio.
4. Il neurologo confermò alla novizia che i parenti del giovane infortunato volevano | vedere lei/lui | vederla/lo | [CONVENTO/CARTELLO] al più presto.
5. L'alunno disse all'impiegata che i suoi amati genitori sicuramente dovevano | aspettare lui/lei | aspettarlo/la | [CLASSE/FIANCO] da un momento all'altro.
6. Il postino confidò alla bidella che il nuovo direttore certamente doveva | trovare lui/lei | trovarlo/la | [LETTERA/CAVALLO] efficiente.
7. Il sarto disse alla detenuta che l'inserviente addetta al parlatorio non poteva vedere lui/lei | vederlo/la | [AGO/OCA] da quella posizione.

8. Il commesso disse alla maestra che i parenti venuti dalla Francia volevano | salutare lui/lei | salutarlo/la | [NEGOZIO/MATTINO] prima della partenza.
9. La laureanda confidò al domestico che l'ultimo arrivato tra i commensali doveva | vedere lui/lei | vederlo/la | [CASA/ANNO] immediatamente.
10. La diva disse all'operaio che il regista e il produttore certamente dovevano conoscere lui/lei | conoscerlo/la | [FABBRICA/PROCESSO] già.
11. La novizia notò con lo zio che il noto cardiologo venuto da Parigi non poteva ricevere lui/lei | riceverlo/la | [PARENTE/MINIERA] in giornata.
12. La cuoca disse al neurologo che i ragazzi più grandi volevano passare a | salutare lui/lei | salutarlo/la | [CERVELLO/MEDAGLIA] l'indomani.
13. La detenuta fece notare all'alunno che il direttore sarebbe stato contento di | ricevere lei/lui | riceverla/lo | [CARCERE/LIVELLO] subito.
14. La psicologa avvertì il mago del fatto che i congressisti riuniti già da alcune ore volevano | ascoltare lei/lui | ascoltarla/lo | [LETTINO/FORMICA] al più presto.
15. La bidella osservò con il sarto che la signora Brugnolini non poteva mai | ricevere lei/lui | riceverla/lo | [CAMPANELLA/PASSAPORTO] dopo le 16.
16. La maestra confidò al postino che il vigile ed il segretario comunale volevano | multare lei/lui | multarla/lo | [SCUOLA/MINUTO] per eccesso di velocità.
17. Il biologo disse a mia figlia che l'impiegato del centro stampa poteva | aspettare lei/lui | aspettarla/lo | [PADRE/PAESE] solo fino alle cinque.
18. Il guardiano fece notare alla bambina che l'anziano parroco del paese vicino voleva | conoscere lei/lui | conoscerla/lo | [FIOCCO/FLOTTA] al più presto.
19. Lo sposo disse alla segretaria che la corista francese di cui avevano parlato voleva | salutare lei/lui | salutarla/lo | [UFFICIO/MERCATO] prima di partire.
20. Mio cognato disse alla fotografa che il barista assunto il mese prima non poteva | sentire lei/lui | sentirla/lo | [IMMAGINI/CASTAGNA] da quella distanza.
21. Il cortigiano disse alla ballerina che il sacerdote di cui avevano parlato voleva | vedere lui/lei | vederlo/la | [CASTELLO/PETROLIO] l'indomani.
22. Il servo disse a mia suocera che il fornitore di frutta e verdura doveva | aspettare lui/lei | aspettarlo/la | [SCHIAVO/MISTERO] giù al portone d'ingresso.
23. Il pellegrino fece notare alla contadina che il signore del villaggio vicino doveva | aspettare lui/lei | aspettarlo/la | [PIEDI/PORTA] quella sera stessa.
24. Il ladro disse alla ragazza che il giovane alla fermata dell'autobus non poteva | vedere lui/lei | vederlo/la | [GIOIELLI/CAVIGLIA] da lì.
25. Mia figlia disse al guardiano che il nuovo maestro elementare voleva | conoscere lui/lei | conoscerlo/la | [CANE/SOLE] al più presto.
26. Mia cugina disse al biologo che l'insegnante di disegno tecnico poteva | ascoltare lui/lei | ascoltarlo/la | [SCIENZA/MISERIA] solo dopo la lezione.
27. La mia amica disse allo sposo che il nuovo medico del distretto sanitario non poteva | visitare lui/lei | visitarlo/la | [MATRIMONIO/POMERIGGIO] prima del 13 ottobre.
28. La segretaria disse a mio cognato che il direttore del giornale pensava di

| raggiungere lui/lei | raggiungerlo/la | [FRATELLO/FINESTRA] a Milano col primo volo dell'indomani.

29. Mia suocera disse al cortigiano che il vicario, stanco dal viaggio, non voleva | ricevere lei/lui | riceverla/lo | [NUORA/TETTO] per il momento.
30. La ballerina disse al servo che il vecchio generale in pensione voleva | vedere lei/lui | vederla/lo | [TEATRO/OSPITE] quanto prima.
31. La ragazza notò col pellegrino che il venditore di lupini non voleva mai | servire lei/lui | servirla/lo | [AMORE/TESTA] come si deve.
32. La contadina disse al ladro che il padrone e il suo giovane aiutante potevano | raggiungere lei/lui | raggiungerla/lo | [CAMPO/CIELO] da un momento all'altro.

References

ABNEY, Steven (1987), *The English Noun Phrase in its Sentential Aspect*, PhD Dissertation, Massachusetts Institute of Technology.

BORTOLINI, Umberta, Carlo TAGLIAVINI & Antonio ZAMPOLLI (1971), *Lessico di frequenza della lingua italiana contemporanea*, Milano, Garzanti.

CALABRESE, Andrea (1985), "Pronomina", *MIT Working Papers in Linguistics*.

CHOMSKY, Noam (1981), *Lectures on Government and Binding*, Dordrecht, Foris.

CHOMSKY, Noam (1995a), *The Minimalist Program*, Cambridge (Mass.), MIT Press.

CHOMSKY, Noam (1995b), "Bare phrase structure", in G. WEBELHUTH (ed.), *Government and Binding and the Minimalist Program*, Blackwell, Oxford.

CINQUE, Guglielmo (1995), "On the evidence for partial N movement in the Romance DP", in G. CINQUE, *Italian Syntax and Universal Grammar*, Cambridge, Cambridge University Press.

CLIFTON, Charles, Lyn FRAZIER & Patricia DEEVY (this volume), "Feature manipulation in sentence comprehension".

CORBETT, Greville G. (1991), *Gender*, Cambridge, University Press.

CORBETT, Albert T. & Frederich R. CHANG (1983), "Pronoun disambiguation: Accessing potential antecedents", *Memory and Cognition*, 11:283-294.

DE VINCENZI, Marica & Renio JOB (1995), "An investigation of late closure: The role of syntax, thematic structure and pragmatics in initial and final interpretation", *Journal of Experimental Psychology, Learning, Memory and Cognition*, 21:1303- 1321.

DI DOMENICO, Elisa (1995), "Features and functional projections in the noun phrase: The case of gender", Poster presented at the 1995 GLOW Meeting, Norway, Tromsö.

DI DOMENICO, Elisa (1997), *Per una teoria del genere grammaticale*. Padova, Unipress.

FRAZIER, Lyn & Janet D. FODOR (1978), "The sausage machine", *A new two-stage parsing model*, 6:291-326.

FRAZIER, Lyn (1985), "Modularity and the representational hypothesis", *Proceedings of NELS* 12, Amherst (Mass.), GLSA.

GARCIA-ALBEA, José E., Susana DEL VISO & José M. IGOA (1989), "Movement Errors and Levels of Processing in Sentence Production", *Journal of Psycholinguistic Research*, 18/1:145- 161.

GERNSBACHER, Morton Ann (1989), "Mechanisms that improve referential access", *Cognition*, 32:99-156.

GREENBERG, Joseph H. (1978), "How does a language acquire gender markers", in J.H. GREENBERG, C.A. FERGUSON, E.A. MORAVKSIK (eds.), *Universals of Human Language*, Vol. 3, Stanford (CA), Stanford University Press.

HARRIS, James W. (1991), "The exponence of gender in Spanish", *Linguistic Inquiry*, 22/1:27-62.

HOCKETT, Charles F. (1958), *A Course in Modern Linguistics*, New York, The Macmillan Company.

IGOA, José M., José GARCIA-ALBEA & Rosa M. SANCHEZ-CASAS (this volume), "Gender- number dissociations in sentence production in Spanish".

KIMBALL, John P. (1973), "Seven principles of surface structure parsing in natural language", *Cognition*, 2:15-47.

MACDONALD, Marvellen C., Neil J. PERLMUTTER & Mark S. SEIDENBERG (1994), "Lexical nature of syntactic ambiguity resolution", *Psychological Review*, 101,4:676-703.

MARSLEN-WILSON, William D. (1975), "Sentence perception as an interactive parallel process", *Science*, 189:226-228.

MCLELLAND, James L. (1987), "The case for interactionism in language processing", in M. COLTHEART (ed.), *Attention and Performance XII, The Psychology of Reading* (3-36), Hillsdale (NJ), Erlbaum.

MCKOON, Gail & Roger RATCLIFF (1994), "Sentential context and on-line lexical decision", *Journal of Experimental Psychology, Learning, Memory and Cognition*, 20:1239-1243.

MCKOON, Gail, Roger RATCLIFF & Gregory WARD (1994), "Testing theories of language processing: an empirical investigation on the on-line lexical decision task", *Journal of Experimental Psychology, Learning, Memory and Cognition*, 20:1219-1228.

NICOL, Janet L. (1988), *Coreference Processing during Sentence Comprehension*, PhD Dissertation, MIT.

NICOL, Janet L. (1993), "The processing of syntactic dependencies: task- specific effects", Poster presented at 1993 Cuny Conference on Sentence Processing, University of Massachussetts, Amherst.

NICOL, Janet L., Janet D. FODOR & David A. SWINNEY (1994), "Using cross-modal lexical decision tasks to investigate sentence processing". *Journal of Experimental Psychology, Learning, Memory and Cognition*, 20:1229-1238.

NICOL, Janet L. & M. O'DONNELL (this volume), "Pronominal feature distinctions in English".

PERFETTI, Carlo A. (1990), "The Cooperative language processor: Semantic influences in an autonomous syntax", in G.B. FLORES D'ARCAIS, D.A. BALOTA & K. RAYNER (eds.), *Comprehension Processes in Reading* (205-230), Hillsdale (NJ), Erlbaum.

PICALLO, Maria Carmen (1991), "Nominals and nominalizations in Catalan", *Probus*, 3:279-316.

RAYNER, Keith, Marcia CARLSON & Lyn FRAZIER (1983), "The interaction of syntax and semantics during sentence processing", *Journal of Verbal Learning and Verbal Behaviour*, 22,:358-374.

RITTER, Elisabeth (1988), "A head-movement approach to construct state noun phrases", *Linguistics*, 26:909-929.

RITTER, Elisabeth (1993), "Where's gender?", *Linguistic Inquiry*, 24:795-803.

SWINNEY David A., William ONIFER, Penny PRATHER & Max HIRSCHOWITZ (1979), "Semantic facilitation across sensory modalities in the processing of individual words and sentences", *Memory and Cognition*, 7:159-165.

TRAVIS, Lisa (1984), *Parameters and Effects of Word Order Variation*, PhD Dissertation, MIT.