# Introduction

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Recent proposals in linguistic theory (as Chomsky, 1995) pay special attention to features, which are considered the triggers of syntactic movement. It seems thus natural to extend this renewed interest for features to the domain of inquiry of natural language parsing. The studies gathered in this volume investigate the processing of two specific features, gender and number, in a variety of situations which concerns the language involved (English, French, Spanish, Italian) the modality (comprehension or production), the subjects (with normal or impaired speech) and the experimental techniques employed. It is particularly interesting that the main results of such variegated studies lead to a unique line of conclusions which can be roughly summarized as follows:

a) feature processing is structure dependent;
b) features are not processed all alike: in particular, the studies gathered in this volume reveal that there are processing differences between gender and number; in some studies even a difference in the processing of various kinds of gender emerges.

Such findings are particularly interesting not only in relation to processing models that try to do without structural constraints, but also because they deepen and sharpen the study of inflection processing, which has often been considered a monolithic phenomenon.

CLIFTON, FRAZIER & DEEVY face the preliminary ground question of whether feature matching is a structure-dependent or a linear, structure-independent process. Taking a constituent X which must agree in Φ-features with a constituent Y, the processor might activate any Y bearing the same Φ-features, or just the Y(s) in a partiticular structural configuration with respect to X.

The authors examine two different types of feature dependencies: "backward agreement dependencies" such as the antecedent-anaphor relations, and "forward agreement dependencies" such as agreement between a verb and its subject and the sharing of Φ-features between a "filler" (i.e. a moved constituent) and the trace it binds.

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With respect to antecedent-anaphor relations, Nicol (1988) had demonstrated that an NP with appropriate Φ-features for the anaphor was not activated if it occurred in a position where it could not bind the anaphor according to the principles of Binding Theory (Chomsky, 1981). This means that in sentences like (1a) *janitor* and *landlord*, but not *fireman* are activated, while in sentences like (1b) only *fireman* is activated:

(1) a. The landlord told the janitor that the fireman with the gas mask would protect him;
b. The janitor told the landlord that the fireman with the gas mask would protect himself.

More recently, however, Badecker and Straub (1994) have found that the addition of a decoy antecedent (i.e. an NP with Φ-features appropriate for the anaphor) increases processing times even if the decoy is not in a position to serve as an antecedent according to the Binding Theory.

Clifton, Frazier and Deevy convincingly show, on the contrary, through the results of three experiments, that a feature-matching NP in the string between the head of the subject and a reflexive does not interfere with binding a reflexive or finding an antecedent for the reflexive, whether the intervening NP is in prominent position or not.

Forward agreement dependencies are also structure-dependent. In two experiments the authors find that subjects found difficult to judge as ungrammatical sentences like (2a) (2b represents the grammatical counterpart):

(2) a. *Lucine dislikes the people who the manager think know the answers;
b. Lucine dislikes the people who the managers think know the answers.

According to Clifton, Frazier and Deevy, this is due to the interference from the plural generated from the head of the chain, i.e. *people*. They dub this interference the "distant plural effect". The distant plural effect shows the existence of difficulty when a link of the tree must carry number information for two phrases which conflict in number. The distant plural effect may be due to the fact that the features of a moved constituent (i.e. *people* in the above example) are active until its chain is completed or to the fact that the link of the projection path is shared by two distinct syntactic dependencies,





but in either case it demonstrates that feature-use is highly structure-dependent, and that features do not act like "pointers" directly granting memory access to phrases with compatible feature specifications.

This paper, thus, demonstrates that both in backward and forward agreement the use of features is highly structure dependent, although some linearity effects may arise.

Given this, the question that immediately comes to mind is the following: are all features structurally important? The rest of the papers gathered here seem to prove (with evidence from various languages and tasks) that there is a difference in the processing of gender and number information; this difference suggests precisely that only number is structure dependent.

Investigating the use of gender and number information in pronoun antecedents identification in Italian, DE VINCENZI & DI DOMENICO find that only number information is initially used to restrict the activation of pronoun antecedents. The materials of the six experiments reported include all nouns with variable gender of the most productive inflectional class, i.e nouns whose gender has basically the same characteristics of number. The authors conclude that this difference in processing, since it is not due to a different marking or to a different specificity of the two features, and is not language specific, may be due to the different representation of gender and number. According to various proposals in the linguistic literature (Harris, 1991; Ritter, 1993; Di Domenico, 1995 and 1997), there is a difference in the representation of gender and number, both in the lexicon and in the syntax. In particular, according to Di Domenico (1997), gender, contrary to number, is not a syntactic head, but a parasitic feature which does not project its own projection in the syntax. For this reason, while number is a structural information immediately used by the parser in order to restrict the set of possible antecedents for a pronoun, gender is used only in a subsequent stage, maybe in the stage in which semantic and pragmatic information is used to select the intended antecedent of a pronoun.

FAUSSART, JAKUBOWICZ & COSTES had similar findings in French and Spanish although in a different task with respect to De Vincenzi and Di Domenico. The authors wanted to establish, through some experiments in auditory modality, whether a number and a gender violation have the same effect in a lexical decision task, and whether this is true for different languages, namely French and Spanish. The two languages realize gender and number in the same

way orthographically, but in spoken language French, contrary to Spanish, shows an asymmetry between gender and number, in that the plural suffix is not audible.

In the experiments, subjects are orally presented fragments consisting of a determiner plus a following noun. The determiner and noun could be either congruent or incongruent for gender and number.

Although the French and Spanish results are not identical (in French, but not in Spanish, number targets were judged faster than gender targets, maybe due to the fact that gender and number are not equally perceivable in French, as mentioned above), in both languages the authors found a larger congruency effect for gender violations than for number violations.

A gender violation, thus, seems to be more disturbing than a number violation.

The authors draw on some representational hypothesis concerning gender and number such as Harris (1991) and Levelt (1989), which maintain that gender is an inherent property of the stem, and explain their results suggesting that while the detection of a gender violation requires a process of lexical identification, a number violation detection can be performed directly on the syntactic representation, without entering lexical identification.

A different use of gender and number is confirmed also in impaired speech.

Luzzatti & De Bleser analyze the speech of two Italian agrammatic speakers. They investigate subjects ability of gender assignment and number realization for simple, derived and compound nouns, and also the ability of implementation of their spared morpholexical knowledge in syntactic contexts of varying complexity. Both subjects revealed a relatively preserved ability of gender and number assignment for simple and derived nouns and of syntactic implementation of their morpholexical knowledge in simple syntactic contexts. Conversely, a morphological deficit clearly appears in complex syntactic contexts and in the case of gender/number assignment to compound nouns.

As the authors suggest, compounds involve the syntactic notion of headedness, and so the two results go in the same direction: agrammatic speech is not a selective impairment of inflectional morphology, but rather a difficulty of syntactic implementation of morphological knowledge.

The results concerning the assignment of gender and number to compounds are particularly interesting for the issue treated here. At least one of the two patients (DR) shows a relative preservation of gender while number correct responses are nearly chance level.





To assign gender and realize number are two dissociable processes, conclude the authors. This can be due to the fact that the two features are differently represented. With respect to gender, they suggest that it must be coded at the lexical level (Levelt's (1989) lemma level).

Their hypothesis is very interesting, particularly because if it is true that agrammatism affects the ability to implement morphology syntactically (as shown in fact by the different results in simple and compound nouns) the relative preservation of the ability of gender assignment in compounds may reflect the fact that gender is less involved than number in syntactic processing.

Nicol & O'Donnell add a further feature, animacy, to their study. They report a study on English in which errors in number, gender and animacy in pronouns are elicited through the following procedure: Participants were asked to repeat a sentence containing a head NP and an intervening NP, and to produce a tag question (*The girl behind the headmaster got punished, didn't she?*). The intervening NP could match or mismatch with the head NP in number, gender and animacy. The goal of the study was to establish whether these types of mismatch interfered with the pronoun agreement process to different extents. Results showed a significant effect of number mismatch, no effect of animacy mismatch and a small effect of gender mismatch.

The authors relate their results to the fact that the possibility of interference rests on the presence or absence of counterparts. Errors may arise, according to the authors, because a speaker is uncertain about whether a just-uttered sentence contained a given concept (e.g. *girl*) or its counterpart (*girls*): a speaker may loose track of certain featural aspects of the head, and in such cases, the feature specification of the non-head is adopted. If interference arises from a failure to remember all the featural details of a noun, one would expect that phonological differences would reduce the possibility of confusion, since a memory representation for a just-uttered sentence is likely to contain at least some phonological information. Number counterparts exist for most nouns and these are typically phonologically related; gender counterparts exist for many (though certainly not all) human nouns, and few are phonologically related; animacy counterparts do not exist: thus the results pattern is explained.

Igoa, García-Albea & Sánchez-Casas explore the processes involved in encoding gender and number agreement relations within Noun Phrases in Spanish. From their results they conclude that gender and number have different processing *loci* in Spanish (*locus* mea-

ning the processing domain under which a feature is selected, retrieved and assigned during sentence production).

They report two studies of sentence production. The first one is an analysis of spontaneous speech error patterns involving gender and number delitions, additions, substitutions and misplacements.

Number features were found to be more easily exchanged and stranded than gender features. This difference is particularly significant in the case of stranding errors, i.e. cases in which word stems are exchanged while their gender or number suffixes remain in place, as shown in (3a) and (3b) respectively:

(3) a. Una *cuera* de *suelo* (for: Una *suela* de *cuero*)
[A leather sole]

b. Esas *bocas* no han salido de mi *palabra* (for: Esas *palabras* no han salido de mi *boca*)
[Those words have not come out of my mouth].

The second study reported is an experiment of elicited word exchanges in complex NPs with two nouns. The results go in the same direction with respect to those of spontaneous speech. For number, strandings exceeded nonstrandings, while for gender, nonstrandings exceeded strandings to a highly significant degree.

Results of both experiments, thus, strongly suggest that gender and number are not processed alike during sentence production.

With respect to models of sentence processing, Igoa et al. consider Bock and Levelt (1994) and suggest that gender information is more likely retrieved with, and assigned from, the lemma representation of words, whereas number information appears to be retrieved and assigned through the grammatical encoding operations that assemble the phrase structure frames of the sentences.

The second study also revealed an interesting difference related to the gender type of words. Strandings were more frequent for words like *el niño / la niña* (the boy / the girl) and *el amante / la amante* (the male / female lover) than for words like *el libro* (the book) which have a counterpart that is not semantically related (*la libra*, the pound). In this latter word group (which consists of words with inanimate referent), a reduction of number strandings is also observed, suggesting, as the authors observe, that the gender-number dissociation in processing does not equally apply to all gender categories of the Spanish lexicon. Namely, the difference seems to be related to the animacy of the word's referent, which is in turn related to the arbitrariness of its gender.





To sum up, the studies just reviewed reveal a difference in the processing of gender and number in a variety of experimental situations. Some of them point out to a difference among gender types, as well. As we have seen, some of the authors relate their results to representational hypotheses concerning features, others trace back their findings to processing models, or take into play cognitive factors such as short-term memory to explain the differences.

This suggests that the relation between psycholinguistic findings and linguistic theory is not a linear one (see De Vincenzi, 1991) and more work needs to be done in this direction.

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*References*

BADECKER, Willian & STRAUB K. (1994), Evidence that binding principles participate in a constraint satisfaction process. Poster presented at the 7th Annual CUNY Sentence Processing Conference, New York.

BOCK, J. Katherine & LEVELT, Willen J.M. (1994), "Language production. Grammatical encoding", in M.A. GERNSBACHER, ed., *Handbook of Psycholinguistics*, London, Academic Press.

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

CHOMSKY, Noam (1995), *The Minimalist Program*, Cambridge, Mass., 7 The MIT Press.

DE VINCENZI, Marica (1991), "Teorie grammaticali e studi sperimentali del parsing delle frasi", *Sistemi intelligenti*, III/3: 347-375.

DI DOMENICO, Elisa (1995), Features and functional projections in the Noun Phrase: The case of gender. Poster presented at the XVIII Glow Colloquium, Tromsø, June 1995.

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

HARRIS, James (1991), "The Exponence of Gender in Spanish», *Linguistic Inquiry*, 22: 27-62.

LEVELT, Willen J.M. (1989), *Speaking: From Intention to Articulation*, Cambridge, MIT Press.

NICOL, James (1988), *Coreference Processing during Sentence Comprehension*, Umpublished doctoral dissertation, MIT.

RITTER, Elizabeth (1993), "Where's Gender", *Linguistic Inquiry*, 24: 795-803.