

CROSS-LINGUISTIC STUDIES OF THE LATE CLOSURE  
STRATEGY: FRENCH AND ITALIAN

**INTRODUCTION**

The issue of the universality of parsing strategies is a central one in a theory of sentence processing, and addressing this issue crucially requires cross-linguistic data. While the need for cross-linguistic research has been argued about for a long time, and pioneering work has been done in this field (e.g. MacWhinney, Bates and Kliegl 1984), recently there has been increasing awareness that in order to yield significant and productive generalizations it is necessary to identify and clearly specify the level at which the comparison among language structures is to be performed.

A domain in which this has been particularly evident is that of parsing preferences concerning the attachment of modifiers to complex noun phrases. For several years the uncontroversial view has been that constituents such as relative clause modifiers are attached to the last constituent that has been parsed. This view was expressed by a principle of syntactic attachment, called either Right Attachment (Kimball, 1973) or Late Closure (Frazier and Fodor, 1978). However, in recent years there have been contrasting results in different languages, some showing a Late Closure preferences, others showing an Early Closure preference and still some others no preferences at all. Such a situation has motivated several authors to propose alternative hypotheses about parsing strategies. On the one hand, Cuertos

and Mitchell (1988) argue for the existence of language-specific strategies. On the other hand, Frazier and Clifton (1996) propose that different parsing strategies are applied to different types of linguistic constituents (the Construal hypothesis), in particular that relative clause modifiers are not immediately attached to constituents consulting only syntactic information, but rather that their attachment will be determined by a variety of linguistic factors that vary cross-linguistically.

However, a third position is possible: in particular, we believe that the abandonment of Late Closure in favor of a principle of association, or the existence of language-specific strategies may be questioned (see also Gibson, Perlmutter, Canseco-Gonzalez, Hickock, 1996 for a similar idea). In our opinion, in fact, the studies done in different languages have not always adhered to the requirement for the compared structures to be "equivalent" at the level of relevant features.

Let us take the case of the studies on the attachment of relative clauses to a complex noun phrase, as in (1), where the relative clause "that came yesterday" can either refer to the daughter (NP1) or to the woman (NP2).

(1) John met the daughter of the woman that came yesterday.

There are several dimensions along which a cross-linguistic research should be matched in order to provide productive generalizations about what are the initial and/or final preferences of interpretation of the relative clause.

The first obvious dimension is that the type of structure should be the same in the two languages: e.g. either subject or object relative clauses, with the complex noun phrase in either subject or object position. It is a well known fact (Sheldon, 1974) that relative clauses in which the head noun has the same role in the main and the relative clause are earlier acquired and

faster comprehended. Imagine then a cross-linguistic study whose goal is to establish whether there is a universal attachment preference of relative clauses to complex noun phrases. Imagine that the research compares the attachment preference of a complex noun phrase in subject position, using a subject relative clause in L1 and an object relative clause in L2. It is likely that the outcome would show a preference for an early closure attachment of the relative clause stronger in L1 than in L2, simply because in L1 the head noun of the complex noun phrase has the same (subject) role in the main clause and in the relative clause. In other words, it would be still entirely possible that the attachment preferences are the same in the two languages, if the grammatical roles of the complex noun and of the relative clause were systematically controlled. Therefore, a cross-linguistic comparison that did not keep the studies parallel along this dimension could give rise to differences in the preference of the relative clause attachment that are not due to language specific effect, but rather to the application of some other principle (such as the parallel function) favoring one structure over the other.

The second dimension along which to match a cross-linguistic comparison is that the linguistic means of disambiguation of the attachment should be the same in the two languages: either grammatical or pragmatic. For example, if L1 has morphological agreement between the relative clause and the head noun and L2 does not, any difference found between the two languages cannot be attributed to different strategies in processing relative clauses, but rather it could be attributed to the parsing differences in the use of pragmatic and grammatical information. For example, within a modular processor, the two types of information are used at different processing stages and therefore an initial attachment preference cannot be picked up by the time pragmatic information comes into play. Evidence for

such a difference can be found comparing Clifton (1988) and Carreiras and Clifton (1993); see also Igoa and Carreiras (personal communication).

A third important dimension is the methodological one, in at least two aspects. The first aspect is that the point of disambiguation has to be *comparable* in both languages. If, by hypothesis, in L1 the point of disambiguation is shortly after the attachment point and in L2 the disambiguation comes some constituents afterward, then different attachment preferences cannot be attributed to language specific difference, but to the timing operation of the language processor (cf. De Vincenzi and Job, 1993).

A second methodological aspect concerns the presentation procedure used in the experiments: whenever there are different segmentation, presentation procedures, or dependent measures, the results cannot be directly compared, but they have to be evaluated in terms of what parsing stages the different segmentation, presentations or dependent measures reflect (cf. Ferreira and Henderson 1990; De Vincenzi and Job, 1996; Gilboy and Sopena, 1996; Henstra, 1996; Brysbaert and Mitchell, 1996).

### COMPARING FRENCH AND ITALIAN

The present work focuses on the attachment of relative clause modifiers comparing French and Italian with respect to immediate and final interpretation, in order to collect empirical data on the universality of the Late Closure strategy. There are several reasons for this comparison. The first one is that in French, in sentences similar to (1), there seems to be an extremely high preference for an Early closure interpretation of a relative clause (Zagar et al., 1997). Sentence fragments like (2) were completed with an adjective agreeing with the first NP (the barrister) 96% of the time:

(2) Un journaliste aborda l'avocat de la chanteuse qui semblait plus...

(A journalist approached the barrister(masc) of the singer(fem) who seemed more....)

This very high preference is at odds with the results obtained in other languages (cf. data from Spanish and English in Frazier and Clifton, 1996; data from Italian in De Vincenzi and Job, 1993), where the percentage of Early Closure interpretation in similar structures (such as (1)) varies from 50% to 67%. The first question then is: is there something really language specific about French, or is the difference due to the linguistic material used? In other words, are the structures in (1) and (2) really comparable? To answer this question, we tested final interpretation in French using exactly the same structures tested in American-English and Italian, namely sentences as (1).

The second reason to perform an accurate comparison between French and Italian is that there are differences in the *on-line* reading studies results. In Italian, De Vincenzi and Job (1993; 1995) have shown that there is an initial preference to attach the relative clause low (to NP2) with prepositions such as "de" ("of") and with thematic assigner prepositions (such as "with", "avec"). In French, however, Frenck Mestre and Pynte (this volume) and Zagar et al. (1997) have shown that an initial preference to attach the relative clause low is detectable only with a thematic assigner preposition ("avec"); when the preposition is "de" ("of"), there is an initial preference to attach the relative clause high (to NP1).

This difference found in French in the *initial* attachment between the two types of prepositions is compatible with the Construal hypothesis, which claims that relative clause modifiers are initially associated with the last thematic domain and a variety of factors determines initial interpretation. For example, Frazier (1990) has shown that there is a pragmatic

preference (the Relevance Principle) to interpret a relative clause as relevant to the main assertion of the sentence. In sentences like (1) the main assertion is the main clause "John met the daughter". The relevance principle then predicts that the preference should be to interpret the relative clause as referring to "the daughter", rather than to "the woman". However, when the complex noun phrase contains a thematic assigner, such as the preposition "with" (cf (3)), then the last thematic domain to which the relative clause is associated contains only NP2.

(3) John knew the boy with the strange girl-friend who was sitting in the kitchen.

The availability of only NP2 in the last thematic domain predicts then a preference for NP2 attachment of the relative clause.

The Late Closure theory predicts the same final preferences as Construal. However, the critical difference is in the initial attachment. Late Closure predicts that initial attachment is performed by a syntactic parser which is blind to the thematic properties of the sentence, and therefore it predicts an INITIAL attachment to NP2 for either type of preposition. When the pragmatic parser comes into play, the Relevance principle will favor an Early Closure interpretation. If at the level of the discourse representation NP1 is available, then the parser may re-analyze the structure as an Early Closure structure in order to get a more pragmatically plausible analysis. However, NP1 is available to be construed with the relative clause only when NP1 and the relative clause are *within the same thematic domain*. In cases like (3), NP1 is not in the same thematic domain as the relative clause, and therefore the re-analysis of the attachment from NP2 to NP1 will not be performed because to reinterpret a constituent as outside of its current thematic domain is costly (cf. Pritchett, 1988; De Vincenzi and Job, 1995, p. 1309; Frazier and Clifton, 1996).

The Late closure hypothesis, then, at least in the version proposed by De Vincenzi and Job (1995), predicts the same off-line preferences as Construal, namely an Early Closure preference for the preposition "OF", but a Late Closure preference for the preposition "WITH". However, crucially, the INITIAL attachment preferences should always be Late closure for the different types of prepositions, and, other things being equal, for different languages. The precise assessment of the initial attachment preference for the preposition "de" is therefore crucial to discriminate between parsing models, both within a single language and across different languages.

In this French-Italian comparison, the linguistic material was chosen matching all the factors that are relevant for drawing a cross-linguistic comparison, and actively controlling the inevitable differences (i.e. word phonology). We chose French constructions parallel to the Italian one that we have already studied (De Vincenzi and Job, 1993; 1995 experiment 1) and whose disambiguation was performed in an analogous way in the two languages. In the on-line study also the presentation procedures, the segmentation of the sentences and the dependent variables recorded were closely matched in the French and Italian studies.

## MATERIAL

Sentences containing a complex NP of the form (definite article -Noun1 -Preposition -definite article -Noun2) were used, followed by a subject Relative Clause (RC). They were originally used by Clifton (1988) in English, by De Vincenzi & Job (1993, 1995 Experiment 1) in Italian and were translated into French.

The complex noun phrase was always in the object position of the main clause. The relative clauses were subject relatives, i.e. the head of the clause was the subject of the clause. This was

done in order to permit (gender) agreement of the verb to disambiguate the attachment of the relative clause in both languages. With respect to this aspect, French and Italian are similar in that they have a morphological system with gender marking on the determiner, on the noun, on the adjective and on the past participle.

However, some differences exist. In Italian, in singular forms, gender marking on the past participle is always "a" for agreement with a feminine noun and "o" for agreement with a masculine noun. Gender marking on the noun is more variable. For animate/human nouns, the most productive class uses "a" for feminine and "o" for masculine marking, but several exceptions exist. For example, several masculine and feminine nouns end in "e": "leone" (lion, Masculine); "pulce" (flea, Feminine)<sup>2</sup>.

In French, for most animate human nouns and for past participles the feminine form is obtained by addition of the inflection "e" at the end of the masculine form (see examples in (4a)). However, also in this case several exceptions exist, including invariable forms ("pianiste", the pianiste).

- (4a) Italian: maestr-o maestr-a  
           teacher-M teacher-F  
       French: avocat avocat-e  
           lawyer-M lawyer-F

A noteworthy difference between French and Italian is that in French gender marking is generally apparent only in written language, and there is no distinction at the phonological level. In Italian, instead, the gender suffix is always pronounced. See examples in (4b).

- (4b) Italian: ferito ferita  
           /ferito/ /ferita/  
           hurt(M) hurt(F)  
       French: blesse blessee

/blesse/ /blesse/  
 hurt(M) hurt(F)

In the two studies to be reported below, sentences containing the preposition "de" (of) or the preposition "avec" (with) were used. This manipulation was introduced in order to test the role of thematic structure in attachment preferences. The two prepositions differ in their thematic properties. In particular, only "avec" is a thematic assigner. As noted earlier, several theories (Pritchett, 1988, De Vincenzi and Job, 1995, Frazier and Clifton, 1996) predict that analysis or re-analysis of a constituent outside a thematic domain is dispreferred. This means that there should be a stronger preference for low attachment with "avec" than with "de".

Further, this manipulation allows us to directly test Late Closure (or any recency/proximity preference model, cf. Gibson et al., 1996) against Construal. In fact, Late Closure predicts an INITIAL preference to attach the RC low for all prepositions, while Construal predicts that the initial association should be already open to a variety of factors, thematic domain included. Therefore, Construal predicts an initial lack of Late Closure effect for the preposition "de".

## STUDY 1

The first study was a questionnaire study in which university students were asked the preferred interpretation of the relative clause attachment by marking one of the two possible answers.

### Materials and procedure

Eight sentences contained the preposition "de" (of), and 8 sentences contained the preposition "avec" (with). The NP1 and NP2 concerned always human protagonists of the same gender. In order to introduce an ambiguity into the relative clause attachment, the gender was balanced having half of the

sentences containing male protagonists and the other half female protagonists (see examples 5 and 6 with the corresponding English translation).

(5) NP-Verb-[NP1-de-NP2-Relative Clause].

Le docteur appelait la fille de la dame qui s'etait  
blessee a' la main.

Qui se blessa?            fille    dame

(The doctor called the daughter of the woman  
who hurt herself in one hand)

Who hurt -self?            daughter    woman

(6) NP-Verb-[NP1-avec-NP2-Relative Clause].

Le cuisinier observait la cliente avec la dame qui  
s'etait plainte des plats.

Qui se plaignit?            cliente    dame

(The cook observed the client(F) with the woman  
who complained for the food)

Who complained?            client(f)    woman

Sentences were randomized in the questionnaire as was the order of the nouns in the question (NP1/NP2 and NP2/NP1) but every subject received the same order of sentences. The experimental sentences were mixed with 20 filler sentences of a variety of syntactic structures, containing no complex noun phrases.

### Participants

91 students of the University of Nice took part in the study.

### Results

Percentages of Late Closure preferences are reported in Table 1, along with the American English data (Clifton, 1988) and the Italian data (De Vincenzi and Job, 1993). The results show a similar pattern across languages: there is a strong preference for the Late Closure interpretation with the preposition WITH while

with the preposition OF there is a small preference for the Early Closure interpretation.

	French	American English	Italian
de (of)	44.5	45	49
avec (with)	76.3	64	70

Table 1: Percentage of Late Closure preferences in the questionnaire studies

These results are important because they show that similar off-line preferences are found across languages that differ at the typological level. French and Italian, contrary to English, have a rich morphological system and a relatively free word-order. While this result is at odds with the 96% Early Closure preference reported for French by Zagar et al. (1997), also quoted in Mitchell, Cuetos and Zagar, 1990), it is entirely consistent with the result of a frequency count reported by Charolles who analyzed a corpus derived from the newspaper *Le Monde* (quoted in Mitchell, Cuetos, Corley, & Brysbaert, 1995). For the structure NP1 de NP2, Charolles found 53,4% attachments of the RC to NP2 (i.e, a slight Late Closure Attachment preference).

The inconsistency between the questionnaire data reported by Zagar et al. (1997) for French and the present data illustrates the problem of the comparability of structures not only across languages, but even within a language. We shall address this point in the final discussion.

### STUDY 2

A reading time experiment was performed using the same material as Study 1. We varied the gender of one of the noun of the complex noun phrase, so that the two nouns had different gender and the relative clause attachment could be disambiguated by the gender marking of the relative clause verb

(see examples in Table 2). The purpose of the experiment was to investigate whether the initial Relative Clause attachment preferences are the same as the final ones, or whether, as found in Italian (De Vincenzi and Job, 1995, Experiment 1), there is an initial preferred attachment determined by the application of the Late Closure principle.

### Material and Procedure

The sentences used in the Questionnaire study were presented one at a time on a computer screen. Each sentence was divided in five segments as shown in Table 2. They were presented using a moving-window, non-cumulative self-paced presentation. Each sentence was followed by a comprehension question that queried the attachment of the relative clause. The question appeared all at once on the screen, with the two nouns referring to the two alternatives appearing underneath it. The question never carried any gender marking (which would immediately disambiguate what the correct answer was) and this was ensured by using the simple past form of the verb. The reciprocal order of the two nouns in the question was counterbalanced, to avoid order biases. The subjects had to answer by pressing a left or a right button, corresponding to whether the correct noun appeared to the left or to the right side of the screen. Examples of the experimental material are given in Table 2. A full list of the experimental sentences is in the Appendix .

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Type of Preposition: DE

L'avocat suspectait\le pere\de la fille\qui s'était trahi(e)\au proces.  
Qui se trahit? Fille - Pere

L'avvocato diffida\del padre\ della ragazza\ che si e` tradita -o\ al processo.  
Chi si tradi`? Ragazza - Padre

The lawyer suspects\the father\ of the girl\ who betrayed her -himself\ at the trial.  
Who betrayed -self? Girl - Father

Type of Preposition: AVEC

Personne n'invitait\le directeur\avec la belle amie\qui etait reste(e)\pour boire.  
Qui resta pour boire? Amie - Regisseur

Nessuno invito`\il regista\ con la bella amica\ che era rimasta -o\ a bere.  
Chi rimase a bere? Amica - Regista

Nobody invited\ the movie director\ with the beautiful girlfriend\ who remained+F -+M\ to drink.  
Who stayed to drink? Girlfriend - Movie director

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Table 2. Example Sentences used in the Experiment. The Italian version and the literal English translation are given after the French version. Slashes (/) indicate segmentation, double slashes indicate the critical disambiguation segment.

The reading time on each segment of the sentence, the time to answer the comprehension question and the answer to the question were recorded. A repeated measures design was used, incorporating a Latin Square. Each subject saw one version from each sentence pair, and each subject was exposed to all conditions. This means that each subject saw a total of 76

sentences: 16 experimental sentences plus 60 filler sentences of a variety of syntactic forms. Order of presentation of the sentences was randomized for each subject.

### Participants

Forty students of the University of Nice participated in the experiment. They were all French native speakers.

### Results

Data are summarized in Table 3. The mean reading times were computed for each segment. Analyses of variance with repeated measures were conducted on the reading times with both Subjects (F1) and Items (F2) as random factors. Two variables with two levels each were considered: Closure (Late vs Early) and Preposition ("de" vs "avec").

Experimental condition	SEGMENT NUMBER					Question RT	% correct
	1	2	3	4	5		
Argument							
Early Closure	1254	1104	1216	1438	1331	3082	89
Late Closure	1351	1066	1178	1380	1287	3310	55
Adjunct							
Early Closure	1259	1101	1316	1583	1523	4432	47
Late Closure	1202	1073	1376	1380	1288	3371	89

Table 3. Average Reading Time by Different Experimental Conditions in Experiment 1, with Question-Answering Reaction Time (RT) and Percentage Correct

There were no significant effects on the 1st and 2nd segment. On the third segment, where the preposition appeared, there was a significant effect of preposition ( $F(1,39) = 7.301$ ,  $p < .01$ ,  $F(1,12) = 5.097$ ,  $p < .05$ ). Reading time was slower with sentences containing the preposition "avec" than with sentences

containing the preposition "de". Anovas performed on the 4th segment showed a significant effect of Closure ( $F(1,39) = 4.35$ ,  $p < .05$ ,  $F(1,12) = 3.58$ ,  $p = .08$ ) where sentences in the Late Closure Conditions (1380ms) were read faster than in the Early Closure Conditions (1510ms). On the last segment (5th segment) which might show some kind of 'wrap-up' processes, there was a significant effect of Preposition ( $F(1,39) = 4.521$ ,  $p < .05$ ,  $F(1,12) = 8.592$ ,  $p < .01$ ) and a significant effect of Closure, ( $F(1,39) = 6.304$ ,  $p = .02$ ;  $F(1,12) = 18.202$ ,  $p < .001$ ). As in segment 4, Late Closure sentences (1288ms) were read faster than Early Closure sentences (1427ms). The interaction Closure and Preposition was not significant in the subject analysis ( $F(1,39) = 2.733$ ) but was significant in the items analysis, ( $F(1,12) = 8.523$ ,  $p < .01$ ).

In the comprehension task, times to answer the question were shorter for sentences with the preposition "de" than with the preposition "avec" ( $F(1,39) = 7.01$ ,  $p < .01$ ,  $F(1,12) = 6.731$ ,  $p < .025$ ). There was also an effect of Closure significant only by Subjects ( $F(1,39) = 4.727$ ,  $p < .05$ ,  $F(1,12) = 2.884$ ). The interaction Closure x Preposition was significant ( $F(1,39) = 6.347$ ,  $p < .025$ ,  $F(1,12) = 6.456$ ,  $p < .025$ ). Times to answer were longest for sentences with the preposition 'avec' in Early Closure condition, the comparison between this condition and the three others yielding a significant effect ( $F(1,39) = 9.475$ ,  $p < .01$ ).

As far as comprehension accuracy is concerned, there was an interaction between Preposition and Closure,  $F(1,39) = 112.795$ ,  $p < .001$ ,  $F(1,12) = 56.103$ ,  $p < .001$ . This was due to the fact that sentences with the preposition OF were better comprehended in the Early Closure condition, while sentences containing WITH were better comprehended in the Late Closure condition.



## DISCUSSION

The reading time data show an initial preference for a Late Closure attachment of the relative clause regardless of the preposition type. This result confirms the validity of the Late closure preference cross-linguistically since parallel results are obtained with closely matched material in Italian (De Vincenzi and Job, 1995, Experiment 1).

Also the response time and accuracy on the comprehension questions parallel the Italian data, showing a preference for sentences with the preposition "de" to take the Relative Clause as modifier of the first NP and for sentences with the preposition "avec" to take the Relative Clause preferentially interpreted as modifier of the second NP<sup>3</sup>.

However, these results show an interesting effect. Unlike Italian, the French material gives rise to very low accuracy data and to rather long response times in the thematically dispreferred conditions: With the preposition "de" readers clearly disprefer the Late Closure attachment and conversely with the preposition "avec" they disprefer the Early Closure attachment. In other words, French readers seem to show the same final preferences as if the sentences were not grammatically disambiguated. These results are surprising given the gender marking, and introduce a difference with the Italian data.

However, there is no necessity to invoke any language specific strategy here. Gender agreement in French is marked in the written form, not in the oral form. In order to explain this pattern, it is sufficient to postulate that phonological recoding strategies are used by the subjects to hold information in short term memory. Such strategies are essential for sentence comprehension, as shown by Kleiman (1975): A sentence acceptability judgment was impaired by continuous digits repetition, by about the same amount as a phonemic judgments. Vallar and Baddeley (1984) have reported analogous effects

with a neurological patient with a phonological working memory impairment.

Given that phonological recoding seems necessary in sentence comprehension and that the French past participle is phonologically ambiguous regarding gender information, it is likely that the information about gender agreement on the past participle is not fully available when the comprehension task is performed.

## SOME DIFFERENCES WITH OTHER FRENCH STUDIES ON RELATIVE CLAUSE ATTACHMENT

As previously mentioned, researches on French by Freck-Mestre and Pynte (this volume) and by Zagar et al. (1997) show an initial preference for Early closure attachment of the relative clauses to complex noun containing the preposition "de". What could be the reasons for these differences?

One hypothesis suggested by Freck-Mestre and Pynte (this volume) is that the difference is due to a methodological variable: our material contained an equal number of experimental sentences with the prepositions "avec" and "de", and this mixture possibly biased the preference of the preposition "de" for a Late Closure attachment: "...prepositions which have lexical content, such as "with", clearly influence processing. Specifically, they uniformly lead to an N2 preference across languages." (Freck-Mestre et al., this volume). However, as also noted by Freck-Mestre and Pynte, this hypothesis is hardly sustainable given the high proportion of filler sentences we used. Further, we think that we can discard this hypothesis considering that, contrary to what Freck-Mestre and Pynte suggest, there are studies that used ONLY the preposition "de" and still show an initial Late Closure (NP2) attachment preference: these are the cases of Henstra (1996) in English and Kamide and Mitchell (1997) in Japanese. Therefore, there is

independent experimental evidence which excludes the idea that an initial Late closure effect for the preposition "de" is due to a lexical priming of other prepositions in the experimental material.

Our hypothesis for the difference among the studies on French is that the studies above mentioned, and ours, despite superficial similarities, really tested different linguistic constructions. In particular, there are two linguistic dimensions (i.e. types of noun phrases and types of relative clauses) in which the sentences used in the French studies of Frenck-Mestre and Pynte (this volume) and Zagar et al, (1997) are quite different from ours and in a way that we think biases an early closure attachment.

Frenck-Mestre and Pynte material used a complex noun phrase containing two different types of nouns: N1 was always a definite NP, while N2 was always a proper noun, as shown in (7):

(7) John photographed the daughter of Charles who seems more disdainful....

First of all, why to have a systematic difference among the two NPs? The different referentiality character influences RC attachment. Relative clauses can attach to a proper noun only if they are appositive, not as restrictive. Appositive relative clauses generally serve as "parenthetical comments" or "afterthoughts". They are always introduced by a wh-pronoun, never by the complementizer THAT or by an empty complementizer (see 8 a,b,c):

- (8) a. John - who you met last week- is a good teacher.  
 b. \* John - that you met last week- is a good teacher.  
 c. \* John - you met last week- is a good teacher.

Appositive relative clauses are set off in a separate intonative contour by the rest of the sentences. They usually have a pause after their antecedent or a descending tone on the relative clause. In writing, a comma usually separates the appositive relative clause from its antecedent. Given that there was no comma in the experiments, a restrictive interpretation of the relative clause is forced. This means that in sentences like (7) the reader cannot attach the relative clause to the second NP, because, ~~being~~ a proper noun, the attachment would be ungrammatical. To put it simply, in the restrictive reading the attachment of the relative clause in (7) is not even ambiguous, it can attach only to NP1; only in the appositive reading can the relative clause attach to either noun. Therefore, to perform a Late Closure attachment to a proper noun, the reader would have to reinterpret the relative clause as appositive. However, this reinterpretation would be quite hard for at least two reasons: one reason is that an appositive relative clause requires a different intonation pattern, and re-analysis is more costly as it involves stress reassignments, as demonstrated and discussed by Bader (1998) and by Fodor (1998). Second, it is not obvious that appositive relative clauses have the same type of attachment as restrictive relative clauses: for example Cinque (1981/2) suggests that they are to be considered as dislocated structure or even coordinate structures. In this latter hypothesis, an appositive relative clause has a more complex syntactic attachment than a restrictive one. Therefore, it is entirely likely that an initial Late closure preference for the "de" sentences in the Frenck-Mestre and Pynte research, is obscured by the re-analysis due to the revision from the restrictive to the appositive reading. This should not hold for the preposition "avec" where both initial and final preferences favor a Late closure reading.

Another important linguistic aspect is the type of relative clause used by Frenck-Mestre and Pynte (this volume) and

Zagar et al, 1997. We (and almost all of the literature on RC attachment) have used a complex NP followed by a relative clause; the disambiguation was on the verb of the relative clause. They used a more complex structure, namely a complex NP followed by a relative clause with the impersonal verb SEEM and containing a comparative clause; the disambiguation was on the adjective of the comparative clause, as illustrated in (9):

(9) Jean photographie la fille de Charles qui semble plus ddaigneux/se que d'habitude.

The verb SEEM has always a non-thematic subject filled with an expletive or with a raised subject. In (9) the subject of SEEM is a raised subject and the underlying structure of the sentence is (10b), derived from (10a):

(10) a. that T seem [the girl be more disdainful..]  
 b. the girl [CP wh [that [T-wh seems [T1 more disdainful..]

There is also another possibility, namely that the subject of SEEM is coindexed with an entire clause, as shown in (11):

(11) Jean photographie la femme sur le point de mourir, ce que semble une mauvaise idée.  
 Jean photographed the dying woman, which seems a bad idea.

The general point we want to make here is that using a verb which takes non-thematic subjects, such as SEEM, can bias the results because it introduces an extra syntactic chain and, consequently, it invalidates the comparison across languages, if the same structure is not used in both languages.

In fact, in French-Mestre et al. material (cf (9)), at the verb SEEM the subject position cannot be immediately filled, but the reader/listener has to wait for the comparative clause. The actual

assignment of the extraction site of the Relative Clause head is therefore delayed. The initial locality preference that subsumes Late Closure can be overcome by the intervening constituents in those cases where initial and final preferences diverge, i.e. for the preposition "de". Further, we predict that such constructions should show a higher preference for an Early Closure interpretation, in that the temporary assignment of an interpretation to the relative pronoun presumably obeys principles of pronoun interpretation, based on discourse factors (see Hemforth, Konieczny and Scheepers, in press), and not on principles of syntactic attachment. This hypothesis would explain the very high 96% percent of early closure preference interpretation, reported by Zagar et al. (1997) with such structures.

Notice that the use of these different linguistic constructions can give us some interesting information about what affects parsing decisions: for example, we predict that the very same Early Closure should be found in Italian for constructions as (7), with a proper noun as NP2, and for constructions as (9), with an impersonal verb and a comparative clause. In any case, parsing of an appositive versus a restrictive relative clause is a topic that is worth serious investigation, because it could reveal some interesting facts, not only about syntactic parsing, but also about principles of sentence interpretation (cf. Frazier, 1998). Also, the process of non-thematic subjects is worth further investigation.

The point here is how to use this new information. If the goal of these manipulations is to test the universality of parsing decisions and strategies across languages, then the question is ill formed. In our view, a study whose goal is to assess whether a construction is parsed by similar principles in two different languages, should ensure that the same linguistic construction is tested in the two languages (cf. also Frazier, 1999 for a discussion of this topic).

## CONCLUDING REMARKS

The two studies here reported have shown that the final interpretation in both the questionnaire and the on-line experiment is affected by the thematic properties of the complex Noun Phrase. Initial interpretation, instead, is driven by a syntactic principle, namely a preference to attach to the last constituent. These two results support models of sentence parsing that postulate an initial preference to attach modifiers to the most recent constituent such as the model of Kimball (1973), Frazier and Fodor (1978), De Vincenzi and Job (1995), and Gibson et al. (1996).

The data do not support the Construal hypothesis (Frazier and Clifton, 1996) since it predicts an initial attachment preference modulated by the argument structure of the complex noun phrase. In particular, it would predict no initial Late Closure preference for the preposition "de", a result clearly not found in our data.

Finally, our data support a view of the human sentence processor that uses universal parsing strategies, not language specific strategies, as proposed by Cuetos and Mitchell (1988). The comparison here performed shows a remarkably similar pattern across different languages. Also, the apparently different findings between the two languages were accounted for by the unavoidable difference in phonology between French and Italian. Once this difference was explained at the proper level of analysis, we demonstrated that a similar pattern emerges between the two languages. Admittedly, before asserting that a parsing strategy such as Late Closure is universal, many more languages should be tested and there should be falsifications at the appropriate level of analysis. However, we hope that this work demonstrates, at least, that very careful analysis of the differences and similarities across the linguistic material used in

psycholinguistic studies should be carried out before drawing any conclusion across languages.

## NOTES

<sup>1</sup> Within grammatical disambiguation, the two languages should be matched also in the type of morphological disambiguation. For example, if L1 has been studied using gender disambiguation and L2 with number agreement disambiguation, we could expect different results based on the representational and processing difference between gender and number (cf. Nicol, 1988, De Vincenzi and Di Domenico, 1996)

<sup>2</sup> In almost all cases, gender marking is unambiguously given by the noun article: "il", "lo" for masculine nouns, "la" for feminine nouns. However the article is ambiguous if there is elision in cases such as: "l'ape" (the bee, feminine); "l'alce" (the moose, masculine)).

<sup>3</sup> The accuracy rates reported here for French and in the De Vincenzi and Job (1995) for Italian refer to the comprehension questions to all and only the experimental sentences. These rates would be higher if we had counted only accuracy to questions probing filler sentences, as done by Brysbaert and Mitchell (1996).

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## APPENDIX

French Sentences (and their English translation) used in Study 2: Relative Clauses with Gender Disambiguation. On the verbs, the Late Closure version is indicated first, then the Early Closure version.

1. Le docteur appelait le fils de la dame qui s'était blessé(e) à la main.

Qui se blessa? Fils - Dame

The doctor called the son of the lady who hurt her -himself in one hand.

Who hurt self? Son - Lady

2. Le cafetier regardait l'ami de la femme qui était ému(e) devant le bar.

Qui s'émute? Ami - Femme

The bar-tender was looking at the friend of the woman who was silent in front of the pub.

Who was silent? Friend - Woman

3. L'avocat suspectait le père de la fille qui s'était trahi(e) au procès.

Qui se trahit? Fille - Père

The lawyer suspects of the father of the girl who betrayed her - himself at the trial.

Who betrayed -self? Girl - Father

4. Le journaliste interrogeait l'amie du sénateur qui s'était suicidé(e) hier soir.

Qui se suicida? Sénateur - Amie

The reporter interviewed the girlfriend of the senator who killed him -herself yesterday night.

Who killed -self? Senator - Girlfriend

5. Le duc aidait le fils de la couturière qui s'était éventré(e) à cause des dettes.

Qui s'éventra? Fils - Couturière

The duke had helped the son of the dressmaker who shot her - himself for the debts.

Who shot -self? Son - Dressmaker

6. Julie reconnaissait la collègue du dirigeant qui était parti(e) depuis peu.

Qui partit? Collègue - Dirigeant

Tina recognized the colleague of the boss who escaped long ago.

Who ran away? Collègue - Boss

7. Paul connaissait la secrétaire du directeur qui était tombé(e) à la fête.

Qui tomba? Secrétaire - Directeur

Ezio knew\ the secretary+F\ of the boss+M\ who had fainted+M -  
+F\ at the party.

Who fainted? Boss - Secretary

8. Jean flirtait avec la niece du danseur qui s'etait assis(e) dans le  
jardin.

Qui s'assit? Danseur - Niece

Gianni was flirting with\ the niece\ of the dancer+M\ who was  
seated+M -+F\ in the garden.

Who was seated? Dancer - Niece

9. Antoine haissait le garçon avec l'amie qui s'etait exhibe(e) a la  
fete.

Qui s'exhiba? Garçon - Amie

Antonio hates\ the boy\ with the girlfriend\ who performed her -  
himself\ at the party.

Who performed -self? Boy - Girlfriend

10. Tous admirait l'homme avec la fille qui s'etait mis(e) a chanter  
un opera.

Qui chanta? Homme - Fille

Everybody admires\ the man\ with the daughter\ who started her -  
himself\ to sing an opera.

Who sang? Man - Daughter

11. Personne n'invitait le directeur avec la belle amie qui etait  
reste(e) pour boire.

Qui resta pour boire? Amie - Directeur

Nobody invited\ the movie director\ with the beautiful girlfriend\  
who remained+F -+M\ to drink.

Who stayed to drink? Girlfriend - Movie director

12. L'oncle rencontrait le president avec la collegue qui etait  
invite(e) par nous.

Qui fut notre invite'? Collegue - President

The uncle met\ the headmaster\ with the colleague+F\ who had  
been+F -+M\ our guest.

Who had been our guest? Collegue - Headmaster

13. Lucie observait la bonne avec l'ami qui s'etait brule(e) a un  
bras.

Qui se brula? Bonne - Ami

Luca was watching at\ the waitress\ with the boyfriend\ who  
burned him -herself\ on the arm.

Who burned -self? Waitress - Boyfriend

14. Laure enviait la cousine avec le fiance qui s'etait enrichi(e) par  
la drogue.

Qui s'enrichit? Cousine - Fiance

Pina envied\ the cousin+F\ with the boyfriend\ who enriched him  
-herself\ with drug.

Who enriched -self? Cousin+F - Boyfriend

15. Le cuisinier connaissait le client avec la dame qui s'etait  
plaint(e) des plats.

Qui se plaignit? Dame - Client

The cook knew\ the client\ with the woman\ who complained+F -  
+M\ about the food.

Who complained?      Woman - Client

16. Le pretre invitait la fille avec l'ami qui s'etait sauve(e) de  
l'accident.

Qui se sauva?      Ami - Fille

The priest hosted\ the girl\ with the boyfriend\ who saved him -  
herself\ in the crash.

Who saved -self?      Boyfriend - Girl