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Parsing gaps: Evidence from French

A thesis presented to
the University of Ottawa
in fulfillment of the
thesis requirement for the
degree of Doctor of Philosophy
in the Department of Linguistics

by

Johanne S. Bourdages

Ottawa, Canada, 1990



Johanne Bourdages, Ottawa, Canada, 1990



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ABSTRACT

This dissertation investigates the parsing of filler-gap dependencies in French, more specifically those found in the restrictive relative construction.

The primary goal of this research is to examine a question raised by Stowe (1984; 1986) concerning whether the parser has access to islandhood knowledge. Stowe's (1984;1986) results are compatible with the view that this type of grammatical information is readily accessible for the parser's initial analysis. However, her results are ambiguous since in her study, islandhood was confounded with subject position, where she failed to find gap-location effect. This study will examine the CNP-constraint in object position.

A second goal is to examine whether the parsing mechanism postulates a gap in any potential position or only when the position is also a potential end of the sentence. Most of the experiments in the field use sentences where false gaps are located in a position which can correspond to a potential end of a sentence. Thus, the "surprise" effect attributed to false gap filling could also be attributed to the parsing mechanism finding that it did not reach the end of the sentence as expected.

This dissertation provides evidence compatible with

the view that island constraints, in this case the Complex NP constraint, are readily available to the parser; however, it also provides indications that the potential end of the sentence effect is a factor which has to be considered in identifying a gap location.

CHAPTER I

INTRODUCTION

1.0 Preamble

Research in psycholinguistics is generally concerned with the description of a performance model for the Human Language Faculty. Such a model cannot be proposed without any reference to a competence model. Linguistic theory is responsible for proposing a competence model describing, in the general sense, the knowledge one has of his/her language. On the other hand, psycholinguistics is responsible for explaining how this knowledge is put to use. In developing a coherent model of human processing, one must consider these two components, Grammar and the Processing Mechanism, and the relationship between these two components. The relationship between the parsing mechanism and the grammar component is the crux of a debate among researchers in the field. Many attempts to explain this relationship can be found in the literature, but it is still an open question.

This dissertation will address a specific issue related to the relationship between grammar and the parsing mechanism. We are concerned with the type of grammatical information that is available on-line on the initial analysis of complex sentences in French, more specifically Island knowledge.

1.1 Processing filler-gap dependencies

The topic of filler-gap dependencies is of central importance in both linguistic and psycholinguistic research. In linguistics, studies have been interested in determining the constraints governing movement of elements while in psycholinguistics, research has been concerned with the problem of how the language comprehender detects and fills gaps.

In processing filler-gap constructions, the processing device must search for a position where it can unload the filler as the sentence is being processed. Sometimes this process is simple, for example, as in (1).

(1) What did you say to Mary ?

In sentence (1), there is only one possibility: "what" can only be interpreted as the direct object of "say". However, there exist many cases where there is, for a moment, ambiguity about the locus of the gap.

(2) a. What_i do you want Mother to sing ____i for Mary?
 b. What_i do you want Mother to sing for Mary about ____i?

In this example, the two sentences are similar up to the end. The parser must decide where the gap will be located. In sentence (2a), to get the correct interpretation, the gap must be located after the verb "sing", but in

sentence (2b), the right interpretation will be reached only if the parser assigns the filler in the empty position at the end of the sentence. However, the parser will not know that there is another gap until it has reached the end of the sentence, thus creating a temporary ambiguity.

Attempts to explain the routines and strategies of the human parsing mechanism have been the focus of research for a number of years. In early psycholinguistic research, it was hypothesized that the process of sentence comprehension was analogous to the operations of transformational rules. Fodor, Bever, and Garrett (1974) and others argued that this hypothesis was incorrect. In a ground-breaking paper, Fodor (1978) proposed routines and strategies for finding and filling gaps in sentence processing. Since that paper, there has been considerable experimental work on the kind of grammatical information which is used by the sentence processing mechanism in analyzing filler-gap constructions and at what point(s) in parsing various kinds of information are used.

A number of investigations (Crain and Fodor 1985; Frazier and Clifton 1986; Fodor 1978, 1983; Frazier et al. 1983; Stowe 1986) have looked at the processing of filler-gap sentences in English. Lately, researchers have started to look at other languages: Dutch (Frazier 1989), Spanish (Cuetos and Mitchell 1988), Italian (De Vincenzi

1988), but none (to my knowledge) has investigated in a similar framework, processing of filler-gap constructions in French. There have been some studies on the processing of transformational dependencies in French, but these have been mainly limited to relative clause constructions, specifically to determine whether object relative clauses are more complex to process than subject relative clauses (Frauenfelder 1981; Holmes and O'Reagan 1981; Frauenfelder, Segui and Mehler 1980).

1.2 Aim of the dissertation

The present dissertation will focus on the syntactic processing of filler-gap sentences in French, addressing issues similar to those examined by Crain and Fodor (1985) and Stowe (1986). The research is more an extension than a replication of these two studies since we will not compare exactly the same set of sentences. Our study uses filler-gap constructions with a pied-piping preposition as part of the filler. Even though pied-piping serves as a clue to the parser in telling it what kind of object to expect, it does not exclusively determine the actual position of the gap¹. Moreover, this study will provide additional evidence about the accessibility on-line of Island knowledge and at the same time resolve an ambiguity

¹ The gap can appear in different positions after the verb, for example:

- a) Pierre a dit à Marie que Jean est arrivé.
- b) Pierre a dit la vérité à ses parents.

found in Stowe (1984)'s results.

One of the questions that the dissertation addresses is the question of whether the parser has the capacity to look at all options offered by the grammar component before making a decision as to what the structure of the sentence will be, or if the parser is limited by constraints that force it to look at only some of the options (for example, only at phrase structure rules).

One way to determine if the parsing mechanism has access on-line to different types of grammatical information is to look at the way the parser reacts to island constraints. Some researchers (e.g. Stowe 1984; 1986) have looked at the parsing of island-constructions in English. This study investigates the processing of an island-constraint construction in French. If we assume that the parser has access on-line to islandhood knowledge, we predict that we should not get a gap location effect within an island. This implies that binding of a trace takes place as the sentence is being parsed and that the parser considers more than one of the options proposed by the Grammar component.

The dissertation also addresses another issue which has not (to my knowledge) been considered in explaining the functioning of the parsing mechanism. This issue is related to the postulation of gaps within an utterance. Simply stated, it says that a gap will not be postulated

in a position unless this position can represent a potential end of the sentence. For the parser to know that the position it is considering represents a potential end of the sentence, it must have access to different types of grammatical information.

1.3 Organization of the dissertation

The following chapter will present an historical review of the treatment of relative clauses and of the analyses provided over the years for Island constructions. This chapter does not intend to propose any new theoretical development regarding these constructions. It simply wants to present the characteristics and properties of the relative constructions and the evolution of the island constraints.

Chapter three will present a review of the literature on processing filler-gap and island constructions. It will focus on the question of which kinds of grammatical information are readily available to the parsing mechanism. Two major positions will be discussed. First, Crain and Fodor (1985) assumes that more than one type of grammatical information is available on-line to the parser; and, second, Frazier (1979, 1985) who propose that the initial syntactic analysis is assigned on the basis of parsing principles and locality and that certain grammatical information are delayed in favour of others.

Chapter four will describe the methodology used in

the experiment which is at the core of this dissertation. It examines two issues. The first concerns use of islandhood knowledge. Stowe (1984; 1986) assumes that subjects are islands and she proposes that the parser has access to islandhood knowledge. She admits that her results are ambiguous considering the fact that she also obtained an asymmetry in the processing of subject and object gaps in non-island constructions. She used experimental sentences which all contained a subject island, and she questioned whether an island in object position would also be noticed by the processing mechanism. Our goal is to disambiguate Stowe (1984; 1986)'s results about the availability of islandhood knowledge. Second, it examines the question of gap location within a sentence in light of the notion of potential end of the sentence. This chapter describes the rationale of the experiment, the procedure, and presents the results. Our results indicate that a gap-non-location effect is not noticed within an island in object position. This is compatible with the view that the processing mechanism has access to islandhood knowledge. Our results also indicate that the parser does not postulate a gap in a position which cannot be considered as a potential end of the sentence, rendering the results with the island constructions equivocal.

Chapter five will present a discussion of the results

in view of the accessibility for immediate processing of grammatical constraints, and in view of the potential end of the sentence issue. It will also discuss the use of the Self-Paced Reading task to capture information about on-line processing. The importance of cross-linguistic data will also be addressed. The core of research in language processing is done on English; however, if one wants to provide a universal model of the language comprehension mechanism, the field needs to look at a variety of languages in order to see if there exists universal properties for the processing mechanism, and how specific language characteristics can be accounted for in terms of processing. Finally, it will discuss the results in view of the notion of Modularity.

1.4 Summary

This dissertation extends the work of Stowe (1984; 1986) on the use of grammatical constraints in on-line processing. It also introduces the notion of potential end of the sentence as a parameter in gap location procedures.

CHAPTER 2

RELATIVE CONSTRUCTIONS AND ISLANDS

2.0 Introduction

Working in psycholinguistics requires first to understand the syntactic constructions of the language which are being investigated. The first part of this chapter will present the characteristics and properties of the French relative construction, in particular of the restrictive relative. The rest of the chapter is on "Island Constraints", an aspect of competence grammar which will be empirically tested in the experiment to be described later on. This chapter has no intention of proposing a new analysis, but will simply offer a general description of the French relative and island constructions as they are currently presented in the literature.

2.1 Relative construction

The Relative construction consists of an embedded (S') clause where there exists an obligatory anaphoric relationship between a Noun Phrase and another one located outside the embedded clause. Semantically, this embedded clause (S') is seen as a predicate of the external Noun Phrase and its function is to identify an individual or a group of individuals among others.

In English, the Relative clause is described as a

construction which results from the application of a movement rule: WH-movement. In French, the situation seems to be far more complex. After a close examination of the facts, Godard (1988) argues that there exists different types of relative constructions in French, and that a unified movement analysis cannot account for a variety of facts about the relative construction (c.f. the "dont"-relative)¹. However, Godard (1988) maintains that the notion of anaphoric relationship is essential to account for the French relative constructions as a whole.

The output of a movement rule is recognized as a structure where there exists an anaphoric relationship between two elements: the antecedent and the anaphoric noun phrase (the structural gap). The antecedent is usually represented by what is traditionally called a relative pronoun. The relative pronoun can appear in a proposition which is not necessarily adjacent to its original proposition.

- (1) a) Tu connais le garçon avec qui s[je suis sortie__].
(You know the boy with whom I went out.)
- b) Le garçon avec qui s[tu crois que s[je suis sortie__]]
(The boy with whom you think that I went out)

¹ For a detailed description of the relative constructions in French, see Godard (1988).

Traditionally, the form of the French relative pronoun depends on the nature of the function corresponding to the anaphoric Noun Phrase (the empty position): "qui" for subject; "que" for direct object; and for indirect object, a prepositional phrase.

- (2) a) L'homme qui devait venir a changé d'idée.
(The man who was supposed to come changed his mind.)
- b) C'est le garçon que je connais.
(This is the boy that/who I know.)
- c) Le garçon à qui tu as demandé un service est arrivé.
(The boy to whom you asked a service has arrived.)

Without going into the details, it is now generally accepted that que (direct object) and qui (subject) are not considered as relative pronouns anymore, rather they are now described as complementizers² as suggested by Kayne (1976) and Pesetsky (1981). The relative clause introduced by a complementizer would have the following structure:

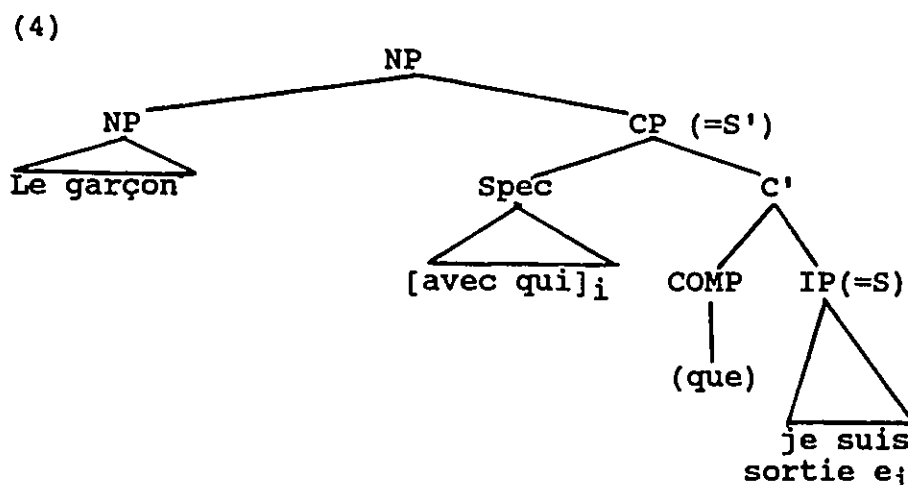
- (3) Le garçon [β_i que] je connais t_i .

In this example, the trace is bound by a covert (phonologically null) relative pronoun which in Chomsky's

² However, whether que and qui are relative pronouns or Complementizers is outside the scope of this discussion. For a detailed discussion see references cited herein and Radford (1988).

(1981) terminology corresponds to an empty wh-operator.

As mentioned earlier, the relative construction is described as the result of the application of a movement rule: WH-movement. This rule moves a constituent from a functional position to a non-Argument position which is not a functional position. Traditionally, COMP was considered to represent a non-functional position, and to receive the moved constituent. In a recent analysis, Chomsky (1986) assumes that WH-movement is not a movement to COMP as typically construed, but rather is a movement to the position of specifier of CP (= S'). Adopting Chomsky's (1986) notation, the internal structure of the relative construction in (1a) would be represented as follows:



There exists a rule in standard French which prevents an overt COMP (in (4) "que") being present when a wh-phrase is moved to the [Spec]_{comp} position.

- (5) a. *Le garçon avec qui que je suis sortie.³
 b. Le garçon avec qui je suis sortie.

Returning to the operation of WH-movement, the constituent moves to the head of the sentence where it must bind its trace. This entails that the relative construction must obey a general constraint called the Empty Category Principle (ECP). Chomsky (1981) defines it as follow:

- (6) ECP - a) Empty categories must be properly governed.
 b) Proper governors⁴ are:
 lexical categories: V, N, A = X⁰,⁵
 the antecedent of the empty category.

This implies that the coindexed constituent in Spec position may act as a governor for ECP, meaning that it c-

³ However, these constructions are possible in some varieties of French, e.g. a variety of Canadian French (Lefebvre 1979)

⁴ A lexical head governs its complements in the phrase of which it is the head. The antecedent must govern its trace and the antecedent-trace relationship must satisfy subjacency.

⁵ The lexical categories mentioned here are proper governors for French.

commands⁶ all of the categories under IP (=S), therefore binding its trace.

The process of relativization in French has to obey a constraint which differentiates it from English. If a Noun Phrase is a complement of a preposition, the preposition is obliged to move with the Noun Phrase in the Spec position. This is what Ross (1967) called "pied-piping".

- (7) a. *Paul qui j'ai parlé avec __
 aujourd'hui.
 (Paul whom I spoke with today.)
- b. *Qui as-tu parlé avec __ aujourd'hui?
 (Whom did you speak with today?)

Kayne (1981a, 1981b, 1983) reformulates Ross' analysis in terms of the Empty Category Principle (ECP). It was mentioned earlier that the relativized constituent had to be properly governed. If we accept that the category P (preposition) is not a governor in French, as suggested by Kayne, then we can explain why structures like in (7) are ungrammatical in French: the trace is not properly governed.

In summary, the French relative clause, similarly to the English relative clause, has been described as resulting for the application of a movement rule, but most

⁶ C-command is a structural notion which can be defined as follows: In a tree structure, a node X will c-command a node Y if and only if the first branching node dominating X dominates Y, and X does not dominate Y, nor Y, X.

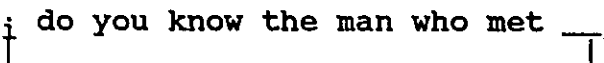
importantly it has been defined as a structure where there exists an obligatory anaphoric relationship between two elements: the antecedent and the structural gap. The main distinction between the English and French relative clauses is the fact that French does not allow preposition stranding because of the reasons provided by Kayne (1981).

2.2 Island Constraints

Within languages such as English and French, there exists a series of structures out of which elements cannot be questioned; the relative clause is one of these constructions.

(8) a. You know the man who met who?

*Who_i do you know the man who met _i ?



b. Tu connais l'homme qui a rencontré qui?

*Qui_i connais-tu l'homme qui a rencontré
|
 _i?

In the ungrammatical (*) examples above, the relative clause contains a structural gap represented by a trace in transformational grammar. This structural gap is related to a constituent found outside of the relative clause.

Over the years a series of conditions has been proposed to explain why it is ungrammatical to question elements which are located within certain structures (e.g. relative clauses). In (8), the WH-questions are

ungrammatical because an element has been moved out from inside a relative clause. Constructions from which movement may not take place are called "islands". Radford (1981:216) defines an island as a construction out of which no subpart can be extracted by any movement rule (though the whole island may be moved in some cases as one unit). The question is now to determine what constitutes an island. Ross (1967) presented a series of specific constraints on the application of movement rules. Chomsky in a series of papers published in the 1970s proposed that many of these conditions could be subsumed under what he has called the "Subjacency Condition". In general terms, the Subjacency condition assumed that for a sentence to be grammatical, no more than one layer can be crossed when performing extraction of a constituent. More recently, the notion of subjacency and its role for accounting for island phenomena has been redefined, taking into account new developments in linguistic theory (cf. Chomsky 1981, 1986).


2.2.1 Ross' Analysis

Ross (1967) proposed a series of constraints on the application or operation of transformational rules. These constraints (Complex NP Constraint, Sentential Subject Constraint, and Coordinate Structure Constraint) account for the fact that a series of transformational rules (e.g. WH-movement, Topicalization, Adverb preposing, etc.) all

lead to ungrammatical sentences when performed from a certain structural position, i.e. from what he called an island.


(9) a. Relative Clause

He knows the man who came with your friend.

*Who does he know the man who came

 with ___?

b. Noun Complement Clause

I heard the claim that you made a mistake.

*What did I hear the claim that you

 made ___ ?

The similar result in the application of WH-movement in both types of sentences allowed Ross (1967) to formulate the Complex Noun Phrase Constraint.

(10) The Complex NP Constraint

No element contained in a sentence dominated by a noun phrase with a lexical head may be moved out of that noun phrase by a transformation.

(Ross 1967:70)

This constraint accounts for the ungrammaticality of sentences such as:

- (11) a) * Who do I know the man who met ___ ?

- b) * What did the paper report the fact

 that John was convicted of ___ ?
- c) * What did Mary believe the claim

 that John had won _____ ?

Parallel facts hold in French.

- (12) a) *Avec qui connais-tu l'homme qui est

 venu _____ ?
 (* With whom do you know the man who
 came _____ ?)
- b) *Qui as-tu vu la personne qui connaît

 _____ ?
 (*Who did you see the person who knows
 _____?)
- c) *Avec qui avez-vous donné des directives

 aux élèves qui attendaient _____ ?
 (* With whom did you give instructions
 to the students who were waiting _____ ?)

At the time when the Complex NP constraint was

formulated by Ross, verbal complement clauses⁷ were analyzed as being dominated by a noun phrase. However, it is now generally accepted to analyze those constructions as being complex clauses directly attached to the verbal phrase (i.e. S' attached to VP). Therefore, Ross' Complex NP Constraint can be reformulated as in (13).

(13) Complex NP Constraint

No element contained in a sentence dominated by a noun phrase may be moved out of that noun phrase by a transformation.

Ross (1967) proposed a second constraint, the Sentential Subject Constraint. This constraint takes into account the difference between sentences where the subject is a clause (14a) as opposed to sentences where the subject is a phrase (14b).

(14) a. [For you to give up Linguistics] would be a pity.

*What would [for me to give up ___] be a pity ?

(Radford 1981:219)

b. [The hoods of which cars] were damaged by the explosion?

Of which cars were [the hoods ____] damaged by the explosion ?

(Ross 1967:133)

⁷ For example: Je pense que tu as tort.

[S [NP Je] [VP pense [NP [S' que tu as tort]

(I think that you are wrong.)

These examples show that movement out of a clausal subject or a sentential subject, is prohibited as opposed to movement out of a phrasal subject. The constraint is formulated in the following way:

(15) Sentential Subject Constraint

No element dominated by an S may moved out of that S if that S is dominated by an NP which itself is immediately dominated by S.

Comparing the formulation of the Complex NP Constraint appearing in (13) with the one proposed by Ross for the Sentential Subject condition in (15), the latter one becomes redundant since (13) can now account for these structures since the subject must be dominated by a Noun Phrase.

In addition to Ross' (1967) constraints, Chomsky (1973) formulated the WH-island constraint which states that wh-clauses are islands and that no constituent can be moved out of any clause containing a wh-phrase in COMP.

(16) The boys knew [_{WH} who liked John]

* Who did the boys know [_{WH} who liked ___]

Chomsky (1973) also proposed the Specified Subject Condition, which asserts that no movement rule can extract an element out of a specified subject. This condition refers to structure such as (17), and can be formulated as follow:

(17) Specified Subject Condition

... X ... [α ... Y ...] ... X ...

No rule can "involve" X and Y where α contains a specified subject, i.e. a subject not containing Y and not controlled by X.

(Chomsky 1977:74)

Within the framework of the Extended Standard Theory, cyclic operations apply to nodes S and NP, and according to Chomsky, the notion of "subject of" is defined not only in S but also in Noun Phrases such as (17) where "John" is the subject, in the extended sense, of the phrase.

(18) John's refusal to leave
 John's picture of Bill
 John's strategy for victory

(Chomsky 1973:239)

The Specified Subject Condition accounts for sentences such as those presented in (19).

(19) We saw John's pictures of his baby.
 You saw John's pictures of who?
 * Who did you see John's pictures of
 — ?

The above mentioned constraints formulated in a general way constrained the grammar; instead of having constraints on the application of specific rule, Chomsky and Ross provided a list of constraints which captured restrictions which governed a variety of constructions.

2.2.2 The Subjacency Condition

Chomsky in the 1970s has argued that the constraints proposed by Ross (1967) and by himself (e.g. WH-island constraint) only achieved descriptive adequacy since they merely list a set of constituents as islands, and do not explain what makes these constituents, as opposed to others, islands.

Chomsky proposed a more general condition on movement rules which he called "Subjacency". He argued that some of the specific constraints postulated in the 1960s could be subsumed under the Subjacency Condition (c.f. Chomsky 1973).

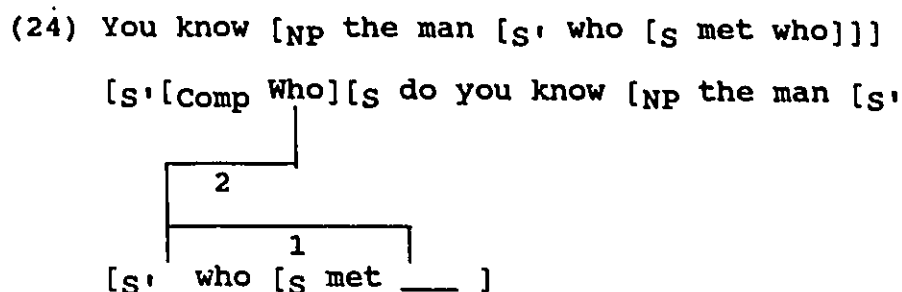
(20) Subjacency Condition

No constituent can be moved out of more than one containing NP- or S-node (i.e. cyclic node) (in any single rule application)

Chomsky showed that Subjacency could account for several of Ross' constraints, but for the purpose of this presentation we will concentrate on the treatment of the Complex NP Constraint.

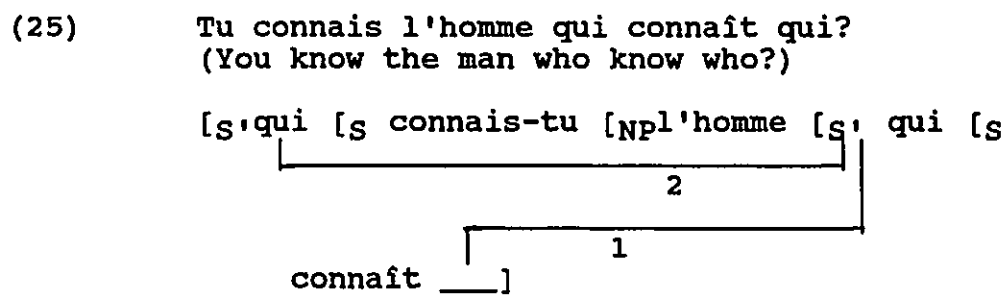
Ross' Complex NP Constraint stated that an element within an NP with a lexical head cannot be moved out of that constituent. Chomsky argued that the Subjacency Condition will account and explain the ungrammaticality of (7) repeated here as (21).

been an issue in the literature. Chomsky (1977, 1981) treated NP (noun phrase) and S (sentence) as bounding nodes for subjacency.



In this derivation, if we accept that S and NP are bounding nodes, then extraction out of S₂ will again be blocked since it would violate Subjacency: movement 2 crossing two bounding nodes (namely, NP and S).

In French, there exists some evidence that movement rules violate subjacency if we take NP and S to be bounding nodes. Sportiche (1981), following basically the analysis of Rizzi (1982), suggests that bounding nodes in French are not exactly those of English. Namely, Sportiche proposes that NP and S' (not S) are to be considered as bounding nodes.



In movement 1, Wh-movement only crosses one node S; in movement 2, however, it crosses S' and NP which are both considered bounding nodes in French, violating the subjacency condition in its movement to the matrix clause.

Lately, Chomsky (1986) has reformulated the Subjacency Condition in terms of the Barriers' model. Again the Subjacency Condition is trying to account for the standard island constraints. In this model, if more than one barrier is crossed, subjacency is violated. The notion of maximal projection is central to this model, i.e. maximal projections constitute barriers.

- (26) γ is a barrier for β iff (a) and (b)
- a. γ immediately dominates δ , δ a blocking category for β .
 - b. γ is a blocking category for β , $\gamma \neq IP$
- (Chomsky 1986:14)

There exists two types of barriers: 1) inherent barriers, 2) barriers by inheritance. In (26), the (b) condition represents inherent barriers, a maximal projection being itself a blocking category. The (a) condition represents the case of barrier by inheritance, where a maximal projection inherits barrierhood from a blocking category that it dominates.

The notion of blocking category is defined by Chomsky (1986:14) as follow:

- (27) γ is a blocking category (BC) for β
 iff γ is not L-marked and γ dominates β .

According to Chomsky (1986) a category α L-marks β iff α is a lexical category that θ -governs β . This assumes that a strict sisterhood condition has to be obeyed.

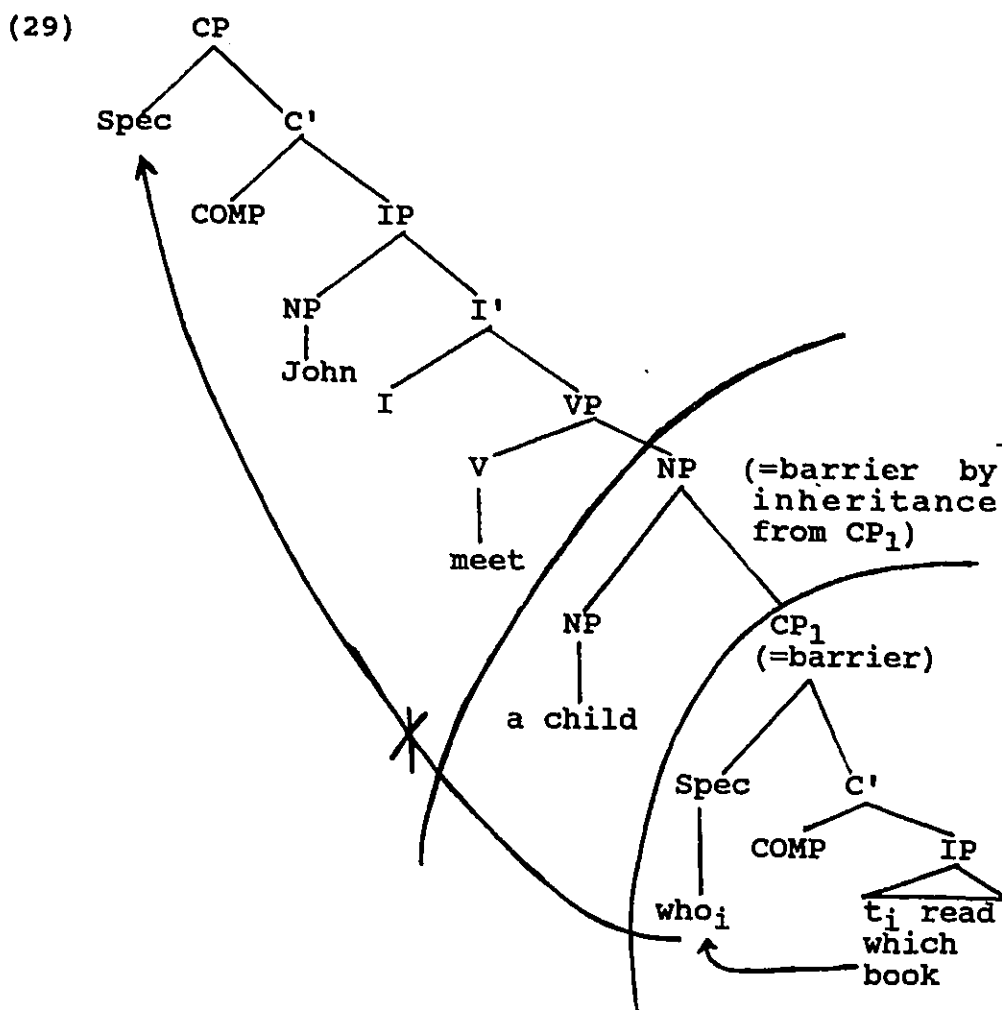
Chomsky, in Section 7 of Barriers, demonstrates how the standard island constraints can be subsumed under the newly defined Subjacency Condition. Again, for the purpose of this dissertation, a discussion of only the Complex NP Constraint will be presented.

- (28) *Which book did John meet [_{NP}a child
 [_{CP}₁who read t]]

(Chomsky 1986:34)

In the above relative sentence, CP_1 is considered a blocking category since it is not L-marked by the Noun Phrase (NP) which is its sister in the tree structure in (29). (In this type of structure, the embedded clause is not subcategorized by the noun phrase as it would be, for example, in a Noun Complement Clause.) The Complementizer phrase, CP_1 , is also a barrier by virtue of condition (b) of the above-mentioned (26). The [_{NP}a child], is L-marked by the verb "meet" since this verb θ -governs it, therefore does not constitute a barrier. However, because it immediately dominates a blocking category, here CP_1 , it

inherits barrierhood by virtue of condition (a) of (26). Movement out of the relative clause would have to cross two barriers, CP_1 and NP, therefore violating Subjacency, and leading to an ungrammatical sentence.



2.3 Summary

This chapter has presented a review of how relative constructions and island constraints, in particular the

Complex NP Constraint, have been analyzed throughout the years in the framework of Generative Grammar. We have seen that these constructions have been described by a series of specific constraints on rule application, in the 1960's and later on, in the 1970's and 1980's, to be accounted for by a more general principle: Subjacency.

The aim of this chapter was to provide a description of the type of grammatical knowledge involved in the processing of restrictive relative clauses in French including the Complex NP island constraint. This description is necessary if one wants to fully understand the exact nature of what is involved in the comprehension process of relative clauses and Complex NP constructions.

CHAPTER 3

PROCESSING FILLER-GAP CONSTRUCTIONS

3.0 Introduction

The topic of the relationship between a structural gap and its antecedent is of central importance in both linguistic and psycholinguistic research. In linguistics, the exact nature of constraints on movement (i.e. island constraints) has been the focus of much research while in psycholinguistics, research has been concerned with the problem of how the language comprehender detects gaps and then determines the relationship between two phrases, the "filler" (the antecedent of the moved or deleted constituent) and the "gap" (the empty position) to which it is related.

In processing filler-gap constructions, we assume that the processing device is actively looking for a position where to unload the filler as the sentence is being processed. This search has been argued to be conditioned by lexical information such as frequency of use of particular subcategorization frames of individual verbs, and possibly by general syntactic constraints and/or general parsing strategies (for recent discussion: see Tanenhaus, Stowe, and Carlson 1987).

There exists an ongoing debate about the type of information needed by the processing mechanism to locate and fill gaps in its initial analysis. There appears to be

two major approach to this problem. One approach is advocated by researchers like Fodor (1978; 1983), Crain and Fodor (1985), Stowe (1984; 1986) who take a position where grammatical information (phrase structure rules, control information, island constraints knowledge) is readily accessible (on-line) to the parser. On the other side, Frazier (1979; 1985; 1987), Frazier, Clifton and Randall (1983), among others, propose that grammatical information used by the processing mechanism is modulated by parsing principles such as, for example, the Minimal Attachment principle (structural principle) and the Most Recent Filler strategy (locality principle).

This chapter will examine two issues related to the kind of grammatical information which is in effect used by the processing mechanism. We investigate the processing of Island constraints in French, in particular, constructions with the Complex Noun Phrase Constraint. The second issue is related to the first one: we want to examine an alternative to explain gap-location procedures based on the notion of "potential end of the sentence". In the first section of this chapter, I will present a review of recent studies on processing-gaps and on processing island constraints, then the experimental design and the results will be described.

3.1 Processing filler-gap constructions

The literature on gap-filling constructions provides

a distinction between sentences with doubtless gaps and sentences with doubtful gaps. Fodor (1978) defines the former as a position in which grammatical knowledge tells the parser that there must be a gap while the latter is a position that might or might not constitute a gap, depending on how the sentence continues. Compare the sentences in (1):

- (1) a. What_i do you want Mother to sing (____i)
for Mary? (doubtful gap)
- b. What_i do you want Mother to make ____i
for Mary? (doubtless gap)

(Fodor 1978)

Fodor (1978) explains that the gap after make is a doubtless gap since the verb make requires a direct object, i.e. it is an obligatorily transitive verb. But, the verb sing does not absolutely need an object, it can be transitive as in (2a), or intransitive as in (2b).

- (2) a. The babysitter sang lullabies to the
baby.
- b. The babysitter sang to the baby.

In the case of sentence (1b), the parser should not have difficulty in locating a gap after make because of the obligatorily transitive nature of that verb. But in sentence (1a), the parser would have to make a decision regarding the transitivity status of the verb sing since it can be used transitively or intransitively.

- (3) a. What_i do you want Mother to sing (____i)
for Mary?
- b. What_i do you want Mother to sing (___)
for Mary about ____i ?

In (3a), for the sentence to be interpreted correctly, the parser must take the verb as transitive since in this case the doubtful gap is the true gap. In sentence (3b) to get the correct interpretation the parser must select the other option, the intransitive one, and ignore the doubtful gap location after sing since there is another gap which is a doubtless gap. However, the information needed to guide the parser in its decision comes at the end of the sentence, creating the possibility of an incorrect interpretation.

As mentioned by Fodor (1978), doubtful gaps create for the processing mechanism a temporary ambiguity between two alternatives:

- (4) a. no constituent was present in the initial structure (i.e. no gap should be present).

or

- b. a constituent has been removed from its initial position (i.e. a gap should be present).

This temporary ambiguity has been exploited by researchers in order to determine the routines, strategies used by the parser when faced with a choice such as the one just described.

In studies performed on English, researchers have often used sentences with preposition stranding to create ambiguous gap positions. The preposed Wh-word may be the same for both subject and (crucially) direct objects and indirect objects.

- (5) a. SUBJECT Who ___ saw John ?
 b. DIRECT OBJECT Who did John see ___ ?
 c. INDIRECT OBJECT Who did John talk to__?

In (5) when the parser gets the word who there is no immediate clue to what it stands for in the sentence. This paradigm allows researchers to create temporary ambiguous sentences such as those in (6) to test different hypothesis about the nature of the parsing process.

- (6) a. Who did you persuade ___ to talk?
 b. Who did you persuade Mary to talk to__ ?

In sentence (6a), the parser may postulate a gap after the verb persuade since it is an obligatorily transitive verb, it requires a direct object, and this analysis is the correct one. In sentence (6b), the parser initially has no clue that wh-word who represents an indirect object. Note that sentences (6a) and (6b) are similar up to the verb persuade. Therefore, the parser may postulate a gap after persuade, as in (6a), and then be "surprised" by the appearance of Mary, potentially needing

time to readjust its analysis. Following Fodor (1985), we will call this effect the gap-non-location effect. Gap-non-location effect is reflected in on-line parsing experiments by longer processing times at positions where the parser may expect a gap and instead gets an overt noun phrase such as Mary after persuade in (6b).

To sum up, the distinction between doubtless and doubtful gaps is based on the lexical information of the verb of the sentence being processed, whether it is obligatorily transitive such as make, or optionally transitive such as sing. This difference has been used to create temporarily ambiguous sentences where the parser has to make a quick decision about the analysis it is computing. Temporarily ambiguous sentences are used by researchers to determine on-line strategies employed by the processing mechanism when computing a sentence.

Different models have been proposed to account for the way the human sentence parsing mechanism detects and fills gaps on the initial parse of a sentence. As mentioned above, there exists two basic opposing views in the literature on processing filler-gap constructions: 1) grammatical information is accessed on-line to guide the processing of a sentence (c.f. Fodor 1978, 1983; Crain and Fodor 1985), and 2) an initial syntactic analysis is assigned on the basis of parsing principles and locality (c.f. Frazier 1978, 1985, Frazier, Clifton and Randall

1983).

3.1.1 Grammatical Information Approach

Fodor (1978) describes three different models for detecting and filling gaps. First, the Last Resort Model which assumes that the parser will locate a gap only as a last solution when all other structural hypotheses have been tried and have failed. This implies, taking into consideration the distinction between doubtless and doubtful gaps, that doubtful gaps will be overlooked on the first parse of the sentence and that reanalysis will need to be performed, having costly implications for the comprehension process. The second model described by Fodor (1978) is called the First Resort Model. This model postulates as a first option the presence of a gap. This has as a consequence that doubtless as well as doubtful gaps will be predicted by the parser. Fodor (1978) proposes a model, the Lexical Expectation model, where the sentence processing mechanism will first adopt an analysis based on the most frequent subcategorization frame of an item and will postulate a gap only if the specified phrase does not lexically appear in that position. Thus, her model assumes that a gap is part of the possible hypotheses which can be looked at by the parser, but more important, that this option depends on the ranking of the various subcategorization frames of a given lexical item. Therefore, Fodor (1978) provides a model where lexical

information is rapidly accessed to compute the structure of a sentence.

Crain and Fodor (1985)¹ are also concerned with the types of information the parser needs to draw on at various stages of processing. Their main concern is to try to settle a debate in the literature: the use of grammatical information over parsing strategies like Most Recent Filler strategy (Frazier et al. 1983). We will return in section 3.1.2 for a detailed discussion of the Most Recent Filler Strategy, but at this point it is necessary to mention that Frazier et al. (1983) hypothesized that the parser will initially ignore grammatical constraints in locating a gap and that it will first adopt a most-recent-filler assignment strategy which states that during language comprehension, a detected gap is initially and quickly taken to be coindexed with the most recent potential filler.

Questioning this hypothesis, Crain and Fodor (1985) compared WH-questions (7) with their corresponding declarative (8) sentences.

7. a) Who_i could [the little child]_i have started ____j to sing NP for ____i PP?²

¹ Crain and Fodor (1985) adopt a Generalized Phrase Structure Grammar (GPSG) parsing system.

² In these examples, NP= 'those stupid French songs', and PP= 'at Christmas'.

- b) Who_i could the little child have forced ___i
___i to sing for Cheryl PP?
 - c) Who_i could the little child have forced us_j
___j to sing NP for ___i PP?
 - d) Who_i could [the little child]_j have begged
___j to sing NP for ___i PP?
 - e) Who_i could the little child have begged ___i
___i to sing NP for Cheryl PP?
- 8.
- a) [The little child]_j could have started ___j
to sing NP for Cheryl PP.
 - b/c) The little child could have forced [us]_i
___i to sing NP for Cheryl PP.
 - d) [The little child]_j could have begged ___j
to sing NP for Cheryl PP.
 - e) The little child could have begged [us]_i
___i to sing NP for Cheryl PP.

In these examples, the verb "start" is considered intransitive and compatible only with a recent filler analysis as in (7a), where [the little child] is the most recent filler for the first gap; the verb "force" is defined as transitive and only compatible with a distant filler analysis as in (7b), where [the little child] cannot be taken as the filler; and the verb "beg" is considered ambiguous as it can be taken as transitive like in (7d) or intransitive as in (7e).

Crain and Fodor (1985) used a self-paced, computer-timed reading task where reading time for each word was recorded. To ascertain that the subjects were

concentrating on the task, they added a grammaticality judgement on a portion of the sentences presented. They recorded reading times for every word but in their comparison they look specifically at eleven positions within the sentence. These positions are illustrated in (9).

(9)

POSITION	DESCRIPTION	EXAMPLES
I	Initial words, not identical across versions	who could the little child have/the little child could have
II	Main verb	started/forced/begged
III	Gap, or single-word object noun phrase	- / us
IV	Complementizer	to
V	Verb of complement clause	sing
VI	All words between V and VII	those stupid French songs
VII	preposition	for
VIII	Gap, or single-word noun phrase	- / Cheryl
IX	First word of adverbial phrase	last
X	All other words in adverbial phrase	Christmas
XI	Sentence-final punctuation	. / ?

(Crain and Fodor 1985:118)

A position could include one word or a sequence of words. Where a position included a sequence of words, the reading time for that position was taken to be the average of the reading times for the words in the sequence. They converted their reading times into z-scores for each subject. For each position tested, they computed an "increase score", for example, at position III (c.f. (9)), the increase score was computed as the mean score of the z-scores for positions IV and V, minus the z-scores for position II. The results presented by Crain and Fodor (1985) are for comparison of increase scores at different positions in the sentences tested.

Crain and Fodor (1985) report that an unambiguous question is not analyzed as if it was ambiguous thus supporting the claim that the unambiguous question is processed in accord with grammatical principles (i.e. phrase structure rules incorporate gap-filling information). Returning to examples in (7) and (8), in (7a) the parser will take as most recent filler [the little child] which in this case is the correct filler. But in (7b) the parser will not take the most recent filler [the little child] to be the potential filler because, according to Crain and Fodor (1985), it is not in accord with the grammatical information provided by the verb "force". Furthermore, Crain and Fodor (1985) found that it was more difficult for subjects to process the

noun phrase "us" in (7c) than in its corresponding declarative (8b). Crain and Fodor (1985) explain that the subjects were not expecting an overt NP to appear after the verb "force" in (7c). The difference in reaction times between the declarative and the wh-question can be explained by postulating that the subjects recognized the wh-filler at the beginning of the sentence as being a filler for a potential gap in direct object position even though the wh-filler is not the most recent potential filler for a gap in this position. Crain and Fodor (1985) conclude that grammatical information is being used on-line to establish the correct relationship between filler and gap. In terms of models of parsing, Crain and Fodor (1985) suggest that the parser is using a procedure by which it actively searches for a potential gap (gap as a first resort) as opposed to Frazier et al. (1983) who propose that the parser uses parsing routines where gaps are postulated only when the parser is forced to do so (gap as a last resort) as explained.

Stowe (1984; 1986) replicates and extends Crain and Fodor's (1985) experiment using for comparison embedded Wh-clauses versus if-clauses of the following form:

- (10) a. I wonder who she knows.
b. I wonder if she knows.

(Stowe 1984:25)

This pair of comparison sentences has the advantage of providing control and experimental sentences which are different only by one word (Wh-word versus If) keeping intact the word order. Therefore, the difference between the Wh-clauses and the declarative sentences is not confounded with a difference in subject-verb inversion, making the complex "increase"-score analysis of Crain and Fodor (1985) unnecessary in Stowe's study.

Stowe (1984; 1986) wanted to investigate a range of possible gap locations. Unlike Crain and Fodor (1985) who only studied the post-verbal position, Stowe (1984; 1986) also investigated the subject position. Stowe wanted to determine whether the subject position is recognized as a potential gap location in the same way as the object noun phrase. Stowe also aimed at verifying if Crain and Fodor's (1985) results were generalizable to other similar structures, in particular embedded Wh-clauses.

Like Crain and Fodor (1985), Stowe (1984;1986) used a self-paced reading task, but instead of using a grammaticality judgement task as a checking procedure on comprehension/attention, she used a repetition task for randomly selected sentences. She collected reading times for every word read by a subject and converted these to z-scores. However, her statistical analyses were performed with both types of scores, and results were considered significant only if they were significant for both the

regular and z-scores.

Stowe (1984;1986) used different versions of embedded wh-clauses which she compared to if-clause constructions serving as control sentences.

- | | | |
|---------|----------------|--|
| (11) a. | IF-Clause | My brother wanted to know if Ruth will bring us home to Mom at Christmas. |
| b. | Wh-Subject gap | My brother wanted to know who ____ will bring us home to Mom at Christmas. |
| c. | Wh-Object gap | My brother wanted to know who Ruth will bring ____ home to Mom at Christmas. |
| d. | Wh-PObject | My brother wanted to know who Ruth will bring us to_____ at Christmas. |

Her results match those of Crain and Fodor (1985). Stowe found a significant increase in processing difficulty for object NPs in Wh-clauses over object NPs in IF-clauses, the position "us" in examples (11a) and (11d). There was a 192 msec difference between the two sentence types (WH-PObject vs IF-clauses) at that specific position. Stowe concurs with Crain and Fodor (1985) in explaining this increase in reaction times by proposing that the parser expects a gap in the object position of the embedded clause and that it is surprised by the presence of an overt noun phrase which forces the parser

to reconsider its analysis.

For subject position (the position Ruth in (11a) and (11c), Stowe (1984; 1986) did not find an increase of processing load for WH-clauses confounded with If-clauses (there was only a 24 msec difference). Stowe concluded that the parser does not apply the same procedure to subject noun phrases and object noun phrases, thus suggesting that gap location procedure is context dependent.

The studies reported in this section indicate that grammatical information seems to be readily accessible to the parser on its first parse through a sentence. The next section will present a different approach.

3.1.2 Parsing Principles and Locality Approach

Another important approach to sentence processing proposes that parsing principles guide the parser in its decision making. The claim is that grammatical information is modulated by parsing principles and effects, implying that all grammatical information may not be available on-line to determine the analysis of a linguistic string.

Part of the question is to determine which grammatical information is readily available to the parsing mechanism. Frazier (1979), and Frazier and Rayner (1982) suggest that when the syntactic category of a lexical item can be determined unambiguously, a single

analysis is initially computed in a word-by-word fashion and that this analysis is based on phrase structure rules. Frazier (1979; 1985) have proposed that, in the initial analysis, structural parsing principles such as Minimal Attachment³ and Late Closure⁴ govern the syntactic

³ Minimal Attachment is defined in the following way:

- (1) Do not postulate any potentially unnecessary nodes.

Frazier (1987) illustrates this principle as in the following example:

- (2) John [vp gave [NP the note [pp to Hans]]].

If the sentence was to continue with "to Mary", then the analysis would need to be revised as in (3):

- (3) John [vp gave [NP the note [pp to Hans]] [pp to Mary]].

⁴ The second structural principle proposed by Frazier (1979), Late Closure, will be called on if the Minimal Attachment principle cannot resolve the ambiguity, and can be presented as follow:

- (1) If grammatically permissible, attach new items into the clause or phrase currently being processed (i.e. the phrase or clause postulated most recently).

In the following sentences, the Late Closure principle predicts that "the sock" will be taken as the direct object of the verb "mending". This prediction will lead to a correct analysis in (2b) but not in (2a), thus (2a) should take longer to process than (2b).

- (2) a. While Mary was mending the sock fell of her lap.
b. While Mary was mending the sock it fell off her lap.

(Frazier 1979:76)

These structural principles are assumed to be used

processing of filler-gap constructions.

The processing mechanism must also account for cases of temporary ambiguity where more than one filler-gap dependency is involved. Frazier, Clifton and Randall (1983) suggest that the parser obeys the Most Recent Filler Strategy which states that during language comprehension, a detected gap is initially and quickly taken to be coindexed with the most recent potential filler. This principle accounts for sentences such as the following:

- (12) a) This is the girl the teacher wanted ___
to talk to ___ .
- b) This is the girl the teacher wanted ___
to talk.

(Frazier et al. 1983:197)

In sentence (12), the verb want is an ambiguous verb where control information is concerned, i.e. want can be transitive, requiring a direct object as in (12b) or intransitive as in (12a). Sentence (12a) represents a Recent filler sentence where the most recent filler teacher can be associated with the first gap (i.e. in this case the verb want requires that its subject also be the subject of the embedded verb), and girl with the second gap. Sentence (12b) is a distant filler sentence where the

whether there is or not a gap-filling dependency in the sentence. They could be called basic parsing principles.

distant filler the girl will be assigned to the subject position of the embedded verb talk. Frazier, Clifton and Randall (1983) hypothesized that a parser using the Most Recent Filler strategy would find Recent filler sentences such as (12a) to be easier to process than Distant filler sentences such as (12b). Following the most recent filler strategy, the initial assignment of the teacher to the first gap in (12b) will be incorrect since there is no other position where to unload the filler the girl⁵. The parsing mechanism will need to revise its initial analysis, taking extra time, implying extra processing difficulty.

Frazier, Clifton and Randall (1983) used a comprehension task where sentences were presented on a computer screen at a pace similar to normal rapid reading. The subjects had to read the sentences and say at the end of the sentence, as quickly as possible, if they understood it or not. This task was designed to test early stages of processing. In order to assess later stages of processing they added a second task. The subjects had to answer orally a comprehension question about the sentence they had just read. Frazier et al.'s prediction is borne out by the results they present: Recent filler sentences took an average of 1071 msec, while Distant Filler

⁵ The noun phrase "the girl" is considered an obligatory filler since it is a noun phrase in a non-argument position, i.e. it is the head of the relative clause.

sentences took 1165 msec indicating that Recent filler sentences were easier to process than Distant filler sentences.

Frazier, Clifton and Randall (1983) also wanted to verify if the Most Recent Strategy was applicable on-line. In order to determine at which stage of analysis the Most Recent Filler strategy is used, they varied the verb in the sentences in order to get unambiguous control information (sentences in 13) while keeping the distinction between Recent and Distant filler sentences (c.f. sentences in 12).

13. a) This is the girl the teacher decided _
 ___ to talk to ___ . (Recent filler)
- b) This is the girl the teacher forced _
 to talk. (Distant filler)

In sentence (13), control information prescribes which filler will be assigned to the subject position of the complement clause. In (13a), the verb decide is obligatorily intransitive forcing its subject the teacher to be the subject of talk. In (13b), control information dictates that the girl be the filler for the gap after force since this verb is obligatorily transitive, i.e. it requires a direct object. If control information is used during the initial analysis, in (13b), it would indicate the girl to be the adequate filler for the gap after force, thus blocking the Most Recent Filler strategy which

would have taken the teacher to be the most potential recent filler. Therefore, sentence (13b) which is a distant filler sentence with unambiguous verb control information should be easier to process than (12b) which only differs by the fact that it has ambiguous verb control information. However, if control information is not readily used, the parsing mechanism will follow the same routine for (13b) as for (12b) making (13b) more difficult to analyze than (13a).

Frazier et al.'s results indicate that control information does not block the use of the Most Recent Filler Strategy: distant filler sentences were more difficult to process independently of whether control information was ambiguous or not. Frazier, Clifton and Randall (1983) conclude that structural information is accessed and used before grammatical information, here, the control information.

Frazier, Clifton and Randall (1983) support the claim that lexical information, such as strict subcategorization and control information, is delayed in favour of the Most Recent Filler strategy. Following this rationale, Frazier (1987) went a step further in proposing the Lexical Filtering Hypothesis.

(14) Lexical Filtering Hypothesis

Item-specific lexical information is used to reject or confirm whatever analysis has been constructed on the basis of purely structural information.

(Frazier (1987:523))

Again, this implies that gaps are not postulated on the basis of purely lexical information but rather that they are postulated using structural principles, and then filtered out (by lexical information) if they are unlikely to appear in a specific position given their lexical context.

As mentioned earlier in this chapter, Fodor (1978) proposed the Lexical Expectation model which predicts the occurrence of obligatory and lexically expected phrases and which stipulates that there is a gap if no lexical phrase appears where a verb's preferred subcategorizations lead the parsing mechanism to expect one. For example, it would, for a transitive verb, first predict a lexical noun phrase, and a gap as a second option if no overt noun phrase appears where it was predicted. However, Frazier (1987) suggests that there exists experimental evidence indicating that the parsing mechanism favors for a time, the gap analysis over the lexical noun phrase analysis. She provides such evidence in her study on processing Dutch relative clauses where the heads of verb phrases are generally phrase-final. This characteristic allowed

Frazier (1987) to investigate whether the syntactic analysis is delayed until the head of a phrase appears (i.e. in Dutch, until the verb appears at the end of the sentence).

(15) Jan houdt niet van de Amerikaanse die de Nederlander will uitnodigen.

(John likes not the American who the Dutchperson wants to invite)

This sentence consists of an ambiguous relative clause which can be analyzed either as a subject relative or object relative clause.

(16) a. John does not like the American who wants to invite the Dutchperson.

b. John does not like the American who the Dutchperson wants to invite.

(Frazier 1987:549)

Using a frame-by-frame self-paced reading task and a comprehension question task, Frazier (1987) compared sentences like (16) to unambiguous relative clause sentences as in (17).

(17) a. Karl hielp de mijnwerkers die de boswachter vonden.
Karl helped the mineworkers who the forester found-plur.

(Karl helped the mineworkers who found the forester)

- b. Karl hielp de mijnwerkers die the
boswachter vond.
Karl helped the minworkers who the
forester found-sing.

{Karl helped the mineworkers who the
forester found.}

(Frazier 1987:550)

In the sentences in (17) the fact that the verb in the relative clause agrees in number with either the subject or the object constitutes the disambiguating element. Frazier's (1987) results indicate that her subjects preferred the subject-relative clause over the object-relative clause interpretation. In sentence (15), the ambiguous relative clause, 74% of the answers to the comprehension task indicated that the subject-relative clause reading was selected. Even with the unambiguous object relative (17b), the head of the relative clause was identified as subject in 31% of the cases. Frazier (1987) concludes that the readers were postulating a gap as soon as they could possibly do so, in the subject position, even before seeing the head of the clause, the verb.

To explain these results, Frazier (1987) and Clifton and Frazier (1989) propose the Active Filler Strategy:

(18) Active Filler Strategy

When a filler of category XP has been identified in a non argument position such as COMP, rank the option of assigning its corresponding gap to the sentence over the option of identifying a lexical phrase of category XP.

(Clifton and Frazier 1989:292)

The Active Filler Strategy constitutes a different way of looking at the process of locating fillers and gaps. This new analysis represents, in a way, a compromise from the previous one advocated by Frazier, Clifton and Randall (1983) where the Most Recent Filler strategy had precedence in associating fillers and gaps. The Active Filler Strategy implies that the parser first recognizes the filler and then proceeds to find a gap to associate with it. However, Frazier (1987) and Clifton and Frazier (1989) propose that the Active Filler Strategy is limited in its application: it is effective in the immediate domain of a filler, i.e. within the immediate clause. If the parser crosses a Sentence boundary (exits the immediate domain) the filler may become inactive, which means that the hypothesis that a filler in a non-argument position is related to a gap in an argument position (which is case-marked) will not be borne out. Frazier (1987) proposes that if this claim is correct, it implies the existence of two distinct gap filling systems: a filler-driven system operative in the immediate domain of a non-argument filler, and, a gap-driven system which executes a backward search for an appropriate filler whenever an obligatory or lexically preferred gap is detected. We can see how this proposal is applied with respect to example (13) reproduced in (19).

- (19) a. This is the girl_j; the teacher_i decided
[s —_i to talk to —_j].
- b. This is the girl_j; the teacher forced
—_j [s to talk].

In (19b) the girl will be recognized as an active filler (it is head of the relative clause), the teacher will not be recognized as an active filler since it is in an argument position (subject of force, receiving nominative case from the verb force). The lexical context allows a gap to appear after force, the active filler will recognize this location as an appropriate gap and will be coindexed with it. In (19a), the girl will also be recognized as an active filler, and again the teacher will be ignored, but since the parser crosses a clause boundary, the girl becomes inactive and the parser must look for an appropriate filler. It will need to go back and, adopting the Most Recent filler analysis, will posit the teacher to be the appropriate filler, leaving the girl to be the only filler left for the gap at the end of the sentence.

This section has summarized studies which claim that not all grammatical information is readily available for on-line processing. They present evidence that on-line processing uses some grammatical information (eg. phrase structure rules, case theory) in conjunction with parsing and locality principles.

3.2 Processing Island Constraints

One way to verify the pertinence of grammatical information during the first analysis of a sentence is to look at sentences to which specific grammatical constraints are relevant and check if and when these constraints are noticed or not by the parsing mechanism. Island constraints are grammatical constraints which prohibit a gap from appearing within certain designated constituents which are called "islands"⁶.

Fodor (1983) suggests that grammatical constraints are part of the parser's routine so that a gap is never postulated where it would be ungrammatical for it to appear. The other position is taken by Frazier et al. (1983) who suggest that island constraints will not be used by the parser and that the parser will "expect" a gap in any position where a noun phrase might occur (i.e any position that is a possible gap location independently of the sentence type). More recently, Clifton and Frazier (1989) have modified this claim by suggesting that island constraints are used by the parser at some point but not during the initial analysis.

Very few studies deal directly with the issue of processing island constraint constructions. The studies mentioned above refer to island constraints while they examine other related issues, but they do not provide

⁶ See chapter 2 for details.

empirical evidence directly related to parsing island constraint structures. Freedman and Forster (1985) and Stowe (1984; 1986) provide such evidence.

Freedman and Forster (1985) used a matching task to verify whether a grammatical constraint violation has the same effect as the misapplication of phrase structure rules in the base. In this matching task, the subjects are presented visually with a pair of sequences of words one above the other (the second one being presented with a short delay to ensure that the subjects read the first sentence), and they are asked to react as quickly as possible by saying if the two sentences are similar or different. The sentences may be different by only one word.

They designed a series of experiments which tested two different types of violations:

1) constraint violations, comprising:

A) sentences with Specified Subject Constraint violation as in (20). The grammatical counterpart or a parallel grammatical declarative of each sentence is given in parentheses, after the example.

(20) a. *What did the scientist criticize
Max's proof of?
(What did the scientist criticize the
proof of?)

b. *What did Ann resent Tom's comments
about?
(What did Ann resent comments about?)

- c. *Who did the duchess sell Turner's portrait of?
(Who did the duchess sell a portrait of?)

and,

B) sentences such as those in (21) with Subjacency violations.

- (21) a. *Who do the police believe the claim that John shot ?
(The police believe the claim that John shot who.)
- b. *What did Jeff decline an offer to take?
(Jeff declined an offer to take what?)
- c. *Ann is hard to trust rumours about. -
(It is hard to trust rumours about Ann.)

2) Rule violations: word order, agreement rule, and quantifier placement violations as in (22).

- (22) a. Word order:

Scrambling of phrases:

*His wife politely the guest introduced.

The guest introduced politely his wife.

Scrambling of words:

*Before sick called home Mike.

John looked tired after work.

b. Agreement rule:

*Mary were writing a letter to her husband.

Mary was writing a letter to her husband.

c. Quantifier Placement violation:
*Lesley's parents are chemical engineers both.
Lesley's parents are both chemical engineers.

They compared these ungrammatical sentences (those marked with a * in (20) to (22)) to their grammatical versions. Their results suggest that the latency differences between the ungrammatical and grammatical versions are due to movement of a constituent rather than to ungrammaticality. In the Specified Subject constraint sentences, they obtained results that were at the opposite of what could have been expected: when the constraint is not present (grammatical sentences) there is an effect of movement showing an increase of 69 msec, however, when the constraint is violated (ungrammatical sentences) the increase in reaction time is only of 38 msec. The interaction between movement and constraint was not found to be significant ($F' < 1$). The same results were found for Subjacency; there was no interaction effect between movement and constraint ($F' < 1$) between grammatical and ungrammatical sentences. As for the experiments on rule violations, they found for every one of the rule violations represented in (22) a significant difference between grammatical and ungrammatical sentences.

(23)

Word order: Grammatical sentences	1262 msec
Scrambling of phrases	1387 msec
Scrambling of words	1610 msec
Agreement: Grammatical sentences	1385 msec
Ungrammatical sentences	1427 msec
Quantifier: Grammatical sentences	1274 msec
Ungrammatical sentences	1340 msec

Mean Reaction times (in msec) for Rule violation experiment

They argue that sentences with constraint violations are perceived as well-formed since constraint violations are cost free for the processing mechanism. This is compatible with the view that gaps are located without any check on constraints.

Freedman and Forster's experiments have been criticized by Crain and Fodor (1987) who argue that the matching task they used does not reveal the linguistic status of the ungrammatical sentences but rather reflects their correctability. Therefore, their results may be looked at with some reservation⁷.

Stowe (1984; 1986) is one study which has the specific purpose of examining processing of island

⁷ For further discussion on this point, see the reply by Forster and Stevenson (1987) to Crain and Fodor's (1987) criticisms.

constructions. Using a self-paced reading task, Stowe (1984;1986) contrasted wh-clauses with if-clauses in order to determine whether a noun phrase position in an island (the complex subject of an embedded clause) is considered a potential gap location. She used sentences with a subject Noun Phrase island which was the subject of an indirect question.

24. a) The teacher asked if the silly story about GREG'S older brother was supposed to mean anything. (IF-SUBJ)
- b) The teacher asked what the silly story about GREG'S older brother was supposed to mean. (WH-SUBJ)
- c) The teacher asked if the team laughed about GREG'S older brother fumbling the ball. (IF-VP)
- d) The teacher asked what the team laughed about GREG'S older brother fumbling. (WH-VP)

(Stowe 1984:46)

Sentences (24a) and (24b) represent constructions with an island: [The silly story about Greg's older brother]. These sentences are contrasted with sentences (24c) and (24d) which do not contain an island construction in the parallel position but rather the prepositional complement to the embedded verb: [about Greg's older brother]. The IF-clauses (24a) and (24c) are used as control sentences for (24b) and (24d) respectively. In this set of sentences (24a-d) the

critical position is represented by [GREG'S] since in sentences (24b) and (24d) where WH-movement has occurred this position could represent a potential gap location. Comparing (24c) and (24d), at the position following the preposition (i.e. at [GREG'S]) there should be an increase in latencies for (24d), since in that sentence Greg's follows a false gap position. The results should thus be parallel to those obtained in Stowe's (1984; 1986) GAP experiment summarized above and those of Crain and Fodor (1985).

Stowe (1984; 1986) hypothesized that interword latency after [GREG'S] should be shorter in the subject island position (24b) than in the verb phrase in non-island position (24d). Stowe (1984;1986) explains that if the parser has immediate access to islandhood knowledge, it will not expect a gap within an island since it would not be considered a grammatical position for a gap. On the other hand, in (24d), the post-verbal position is a location where grammar allows gaps, thus the parsing mechanism can postulate a gap in this position. This means that in sentence (24b), the parser will not be "surprised" by the overt noun phrase [GREG'S] and that in sentence (24d), it will be "surprised" by [GREG'S] and will need more time to revise its analysis.

This prediction was supported by her results: an average of 800 msec was recorded at the critical position,

[GREG'S], in WH-SUBJ sentences compared to 1063 msec in WH-VP sentences. Stowe concludes that long latencies at Noun Phrases due to gap non-location effects are not found in the island position because the parser does not expect to find a gap in this position. There was no significant difference for the IF-control sentences.

Stowe's (1984; 1986) results are however equivocal as she herself points out. Her target sentences were all constituted with an island in subject position (see example 24b). Results of her first Experiment show that: "people do not expect a gap in subject position or that they do not have any problem recovering from the expectation at subject position, unlike object position" (Stowe 1986:238). Therefore, her results from the ISLAND-experiment which demonstrate that the parser does not expect a gap within an island, could be attributed (in part or totally) to this lack of difficulty in subject position.

Stowe (1984) suggests that if results similar to those she obtained with the subject condition can be achieved with islands embedded in the verb phrase, then it would confirm the claim that the parser has access on-line to islandhood knowledge and would therefore not expect a gap to appear within an island.

Clifton and Frazier (1989) used a speeded grammaticality judgement technique to compare sentences

with Complex NP constructions to Wh-Questions with transitive and intransitive verbs. The sentence types they used are shown in (25).

- (25) a. What did John think his friends should win (____?) at ____ ? (Question-transitive verb)
- b. What did John think his friend should excel at _____ ? (Question-intransitive verb)
- c. What did John think [the girl who always won (*__)] received __ ? (Island - transitive verb)
- d. What did John think [the girl who always excelled] received __? (Island - intransitive verb)
- e. John thought the girl should win convincingly. (Control - transitive verb)
- f. John thought the girl should excel convincingly. (Control - intransitive verb)

(Clifton and Frazier 1989:302)

Their results indicate that sentence (25a) took an average of 72 msec more to process than (25b). Between (25c) and (25d), where the ambiguity could be blocked by islandhood knowledge, there was an average difference of 43 msec in favour of (25d). And there was an average difference of only 12 msec between the control sentences (25e) and (25f). Their subjects took longer to make a decision about sentences with preferred transitive verbs ($F(1,130)=11.55$, $p<0.01$), but the interaction between

transitivity and sentence form was not significant ($F(2,260)=2.78$, $p<0.06$). Clifton and Frazier (1989) take these results as only a hint that the parser does not use islandhood knowledge in the initial analysis, and suggest that a stronger form of evidence is needed to clarify this issue.

3.3 Summary

This chapter presented current research on a much debated question: What kind of grammatical information is immediately accessible to the parsing mechanism on its initial analysis of a sentence. This question is in fact very complex since it may determine if a model of processing mechanism is of a modular nature, in terms of Clifton & Frazier (1986; 1989), or whether it has a more monolithic nature, in terms of Crain and Fodor (1985).

The main issue raised by the studies reported in this chapter is central to the current debate about the question of whether grammatical information is available on-line or only after structural (parsing) principles have been used. In other words, the question is whether grammatical information serves as a guide or as a filter for processing sentences, and which grammatical information is available immediately on-line for the parser to use. If it can be shown that Island constraints are used on-line, it would provide evidence to support the claim that grammatical information (i.e. more than what is

assumed for example by Frazier et al. 1983) can be used to guide the initial analysis performed by the parsing mechanism.

CHAPTER 4

PROCESSING GAPS IN FRENCH

4.1 Introduction

This study aimed to investigate two issues. First, it was designed to look further at one of Stowe (1984;1986)'s questions: Can some syntactic constraints be used to avoid postulating gaps where they cannot grammatically appear? The study attempts to disambiguate Stowe (1984; 1986)'s results by using target sentences where the island is located within the verb phrase, in the object position. Under the hypothesis that island constraints are applied immediately in sentence analysis, our prediction is that we will get a similar effect for an island in object position to those which Stowe obtained in subject position. The particular sentences used to test this hypothesis involve Complex NP constructions in French. As mentioned earlier, the Complex NP Constraint (CNPC) is applied in the same fashion in both French and English; the results obtained in this experiment should thus be generalizable to English and other similar languages.

Second, this experiment examines the question of gap location within a sentence, in particular the question of whether the parsing mechanism postulates a gap in any potential position or if it waits for a potential end of a sentence to appear before doing so. In other words, we

want to verify whether it is purely lexical and "island" information that will be considered by the parser in postulating a gap or whether some additional type of information guides the parser in its search for a gap location.

In the literature, it is most frequent to see in constructions used in gap-filling experiments that the false gap position corresponds as well to a potential end of the sentence. Thus, one may question this coincidence of conditions. Could the surprise effect attributed to false gap filling also be attributed to the parsing mechanism finding that it did not reach the end of the sentence as it expected it had?

- (1) a. Who could the little child have forced
[us] to sing NP for ___ PP?

(Crain and Fodor 1985)

- b. My brother wanted to know who Ruth
will bring [us] to _____ at
Christmas.

(Stowe 1984;1986)

In both examples in (1), a false gap effect was found in the post-verbal position [us], longer reaction times were found to indicate that a WH-gap had been postulated and that the analysis had to be revised. In both sentences, the position [us] also corresponds to a potential end of the sentence. Clearly, in order for the parser to know that it has reached the end of the sentence

it needs access to grammatical information such as phrase structure rules, control information, and so on. However, if a false gap effect could be obtained in a position which is not a potential end of the sentence then it would provide evidence in favour of a model of the parsing mechanism which sub-systems interact with each other, and where there is an autonomous gap finding/filling mechanism.

Again, this issue brings us back to the debate between two positions found in the literature; Crain and Fodor (1985) have proposed that there is only one syntactic processing system accounting for all syntactic decisions, as opposed to Clifton and Frazier (1986; 1989), Frazier et al. (1983) and Freedman and Forster (1985) who proposed the existence of sub-systems such as one responsible for structure (constituent) building and another responsible for establishing relations between phrases (e.g. control information).

4.2 Rationale of the experiment

In order to establish processing routines or strategies, researchers have been studying constructions which may present temporary ambiguity to the parser. Temporary ambiguous sentences force the parser to make a quick decision about a number of possible analyses and can reveal if an island construction will block gap-location

and/or gap-filling even in positions where a gap is strongly predicted by lexical usage facts.

As mentioned in section 3.1, in English, many experiments use constructions with preposition stranding. This construction creates temporarily ambiguous sentences, since the preposed WH-word may originate in direct or indirect object positions. However, French does not allow preposition stranding, and the type of manipulation used in the experiments on English cannot be used to test hypotheses about parsing procedures in French. In order to attain our goals we had to come up with structures in French that would create a false gap effect. We achieved this by exploiting the lexical properties of a particular class of verbs: verbs which can take a double avec (with) phrase. A verb such as jouer (to play) and chanter (to sing) can have two prepositional phrases with avec.

- (2) a. Marie jouait avec sa poupée avec son amie.
(Mary was playing with her doll with her friend).
- b. Marie a chanté avec Pavaroti avec la chorale.
(Mary sang with Pavaroti with the choir.)

The semantic role of the second avec-phrase is slightly different from that of the first one. The first object has a role something like "theme" whereas, the second avec-phrase has a semantic role which can be taken

to represent another secondary "agent". In sentence (2a), the sentence as a whole can have the following interpretation: Mary played with her doll and her friend was involved in the playing also. Sentence (2b) can have the following reading: Mary sang with Pavaroti and the choir was also involved in her singing with Pavaroti. Not all native speakers accept double avec-phrases (this will be irrelevant in the experiment to be presented below) but it seems clear that all native speakers of French do find a single avec-phrase to be more natural than a double avec-phrase. It is therefore reasonable to suppose that the parsing mechanism will in the first instance assume that there will be only one avec-phrase in the sentence. It is this assumption that the following experiment exploits. We expect that if the parsing mechanism is looking for a position to unload a filler of the form "avec wh-word", it will first postulate and fill a gap directly after a verb such as jouait in (2a) or chanté in (2b), and second, that the parser will be surprised by the second avec-phrase. Thus in (3), it would be reasonable to expect a false gap filling effect when the parser accesses the second avec-phrase.

- (3) Avec qui Marie a-t-elle chanté avec Pavaroti?
(With whom did Mary sing with Pavaroti?)

We should get longer reaction times after the

preposition following the verb chanté.

We constructed sets of target sentences¹ such as those in (4); the sentences use the double avec construction to both test for a gap-location effect and whether such an effect is modulated by island information.

- (4) a. Avec qui le voisin a-t-il dit à la petite fille qui jouait avec son amie que sa mère est partie vers trois heures? (CNP-Q)

(With whom did the neighbor say to the little girl who was playing with her friend that her mother had left around three o'clock.)

- b. Avec qui le voisin a-t-il dit que la petite fille jouait avec son amie qui est partie vers trois heures? (GAP-Q)

(With whom did the neighbor say that the little girl was playing with her friend who had left around three o'clock.)

- c. Le voisin a dit à la petite fille qui jouait avec son amie que sa mère est partie vers trois heures. (CNP-D)

(The neighbor said to the little girl who was playing with her friend that her mother had left around three o'clock.)

- d. Le voisin a dit que la petite fille jouait avec son amie qui est partie vers trois heures. (GAP-D)

(The neighbor said that the little girl was playing with her friend who left around three o'clock.)

¹ The complete set of target sentences appears in Appendix I.

The verb jouait has as a preferred subcategorization frame [_____ PP]² and can be assumed to lead to the postulation of a PP gap, other things being equal. Sentence (4a) represents a construction with in the first embedded clause a complex noun phrase, here a relative clause, out of which it is impossible to extract a noun phrase. This island is in object position (i.e. is the indirect object of the verb dire). This construction is used to investigate whether the parsing mechanism has access immediately to islandhood knowledge. If so, the parser will not be surprised by the presence of the second avec-phrase since it will ignore the prepositional phrase site as a possible gap location. Sentence (4b) is a sentence where the first embedded clause grammatically permits a gap after jouait, thus the parser should be surprised by the lexically realized avec-phrase after jouait causing longer reaction times to appear in this position. If the parsing mechanism uses the same procedure to process sentences (4a) and (4b) we will not get any difference in reaction time after the preposition avec. However, if a difference is found, this can be interpreted as evidence that the parser takes into consideration the island constraint in assigning gaps.

We also included in the comparison set declarative versions of the sentences (sentences (4c) and (4d))

² See Appendix II for verb subcategorization preferences.

corresponding to the WH-questions in (4a) and (4b). These declaratives control that differences between (a) and (b) are not simply an effect of differences in structure, aside from WH-movement.

The materials also included one other WH-question version which was different from the two others, (4a) and (4b), by having an à qui as opposed to avec qui phrase at the beginning of the sentence.

- (5) A qui le voisin a-t-il dit à la petite fille que son amie avait parlé avant de partir?

(To whom did the neighbor say to the little girl that her friend had spoken before leaving?)

We compared this version to (4a). If we accept the hypothesis that the parser will try to unload the filler in the first potential gap location it encounters, then we should expect that in (5), the position after dire will be recognized as a potential gap location (dire takes an indirect object of the "à NP" form). In (4a), the position after dire cannot be considered as such because the verb dire does not allow a complement of the type "avec NP". Thus, we should expect longer reaction times after the verb dire in (4a) as opposed to (5). However, the position after dire is not a potential end-of-a-sentence; "Jean a dit à Paul." or "A qui a-t-il dit ?" are not complete sentences. If the parser postulates a gap

only in a position that is a potential end of the sentence, we do not expect a difference between (4a) and (5). The comparison between (4a) and (5) thus allows us to investigate whether gap non-location effects are confined to positions which are potential ends of sentences.

4.3 The Procedure

4.3.1 The sample

The sample consists of 40 University of Ottawa undergraduate students who were all native speakers of French³. French was also their daily language of communication. All of them were bilingual with different levels of proficiency in their second language (which was usually English). They all had normal vision, corrected or uncorrected. The subjects were not paid for their participation. The subjects were told that in participating in this research they would have a chance to win \$100 and one subject in twenty received this sum.

4.3.2 The task

The subjects were asked to perform a self-paced reading task. Each sentence was presented in a word-by-word fashion on a monochrome Packard Bell monitor of an

³ The sample consisted originally of 45 subjects. Five subjects had to be rejected since they were not French native speakers.

IBM-PC AT controlled by a CTS card. This CTS card was used to record Reaction times in milliseconds at specified positions within a sentence. This selective recording of reaction times did not interfere with the course of the successive displays. Each word of a sentence appeared alone in the centre of the screen. The subject initiated the presentation of each new individual word by pressing a SCROLL button on a box placed between the subject and the screen on which the words appear. If after a 20 second period, the subject did not press the button for the next word, the computer would automatically replace the word on the screen by the following word of the sentence being read. The last word of the sentence was followed by a period mark which indicated the end of the sentence. To read the next sentence, the subject had to press a START button. The computer recorded the time from presentation of a word on the screen to the pressing for the next word as the reaction time (RT) associated with that word in the subject's data record. Reaction times were recorded for specific positions within the sentences, and not for every word of the sentences. No feedback was given to subjects; time between sentences was not recorded and subjects were able to take a short break if they wished before pressing the START button.

Subjects were instructed that they were to memorize each sentence that appears on the screen and that they

would be asked to repeat randomly chosen sentences. When the subject had to perform this verbatim recall, a computer controlled message appeared on the screen asking them to repeat the last sentence they read. One out of two filler sentences contained in the experiment were repeated by each subject; the same sentences were repeated by all subjects. These repetitions were all recorded on a cassette tape using a Sony TCM-5000.

4.3.3 The questionnaires

A set of 30 experimental sentences was prepared consisting of five versions similar to those given in (2) and (3) (See Appendix II for complete set). Then, five questionnaires were created by rotating versions of target sentences in a way such that no subject received more than one version of a particular sentence. Two pseudo-random orders of sentence presentation were used, creating a total of ten sets of materials.

Each questionnaire consists of 105 sentences: 10 trial sentences, 30 experimental (target) sentences, 30 sentences for repetition, and 35 fillers. No repetition was asked after an experimental sentence was read. All of the 105 sentences used in this experiment were grammatical and pragmatically acceptable. The 35 filler sentences and the 30 repetition sentences were of a variety of forms to counter the possibility of subjects developing experiment-

specific strategies based on superficial properties of the experimental sentences.

The verbs which were selected to appear within the first embedded clause of the experimental sentences all take indirect object of the "avec NP" form. A planned comparison by position was used in this experiment, thus not every position within the target sentences were tested for reaction time. For sentences of type (4a) to (4d) we recorded reaction times at four positions within the first embedded clause: the first position being the verb and the others the three following positions (henceforth V_2 , V_2+1 , V_2+2 , and V_2+3). For the part of the experiment investigating a potential end of the sentence effect, we also recorded reaction times at the first four positions in the sentences, i.e. those after dire and the following three others (henceforth V_1 , V_1+1 , V_1+2 , and V_1+3).

4.4 Results

The experiment consists of a repeated measurement design considering two variables: Structure and Type. These two variables have been considered at four positions within the sentence. The first variable, Structure, represents the two versions of the sentences used in this experiment: sentences with a Complex NP construction in the first embedded clauses (sentence (4a) represented in (6) for ease of presentation), and sentences with the

first embedded clause containing a possible gap (sentence (4b) also in (6) below). The second variable, Type, represents the declarative versus the interrogative form of the selected sentences also in (6).

As mentioned in the previous section, we performed a planned comparison for position. In the following examples, the asterisks represent the positions where reaction times were taken.

- (6) a. Avec qui le voisin a-t-il dit* à* la* petite* fille qui jouait* avec* son* amie* que sa mère est partie vers trois heures? (CNP-Q)
- b. Avec qui le voisin a-t-il dit* que* la* petite* fille jouait* avec* son* amie* qui est partie vers trois heures? (GAP-Q)
- c. Le voisin a dit* à* la* petite* fille qui jouait* avec* son* amie* que sa mère est partie vers trois heures. (CNP-D)
- d. Le voisin a dit* que* la* petite* fille jouait* avec* son* amie* qui est partie vers trois heures. (GAP-D)
- e. A qui le voisin a-t-il dit* à* la* petite* fille que son amie avait parlé avant de partir? (PES)

Before submitting the latencies to an ANOVA⁴ for

⁴ We did not use min F' since this analysis takes as a basic assumption that the items of a test must represent a random sample of all possible items. Our item selection does not meet this requirement because of the specific characteristics of the sentences used in the experiment. The verb selection for the matrix clause is very limited as well as the one for the embedded clause where only

subjects and items, a number of outlier latencies needed to be replaced. An observation was considered an outlier if the latency was three standard deviations above the subject's grand mean. In which case, the outlier was replaced by the grand mean before any statistical analyses were carried out. It is important to note the fact that the number of outliers was indeed quite small in the data. Table I shows the exact number in percentage of the latencies replaced for each position in the embedded clause of sentences such as (6a) to (6d).

TABLE I

positions	v ²	v ²⁺¹	v ²⁺²	v ²⁺³
percentage	2.3%	1.9%	1.1%	9.8%

Percentage of replaced latencies by position

Table II presents the percentage of replaced latencies for each of the first four positions in the comparison between sentences such as (6a) and (6e).

verbs which can accept an "avec NP" object were selected.

Table II

Position	v^1	v^{1+1}	v^{1+2}	v^{1+3}
Percentage	1.6%	0.8%	0.8%	2.75%

Percentage of replaced latencies by position

4.4.1 Complex NP Island

We used regular scores to compute the ANOVA. Table III shows the mean reaction times for the four target sentences (6a to 6d) at the four selected positions.

TABLE III

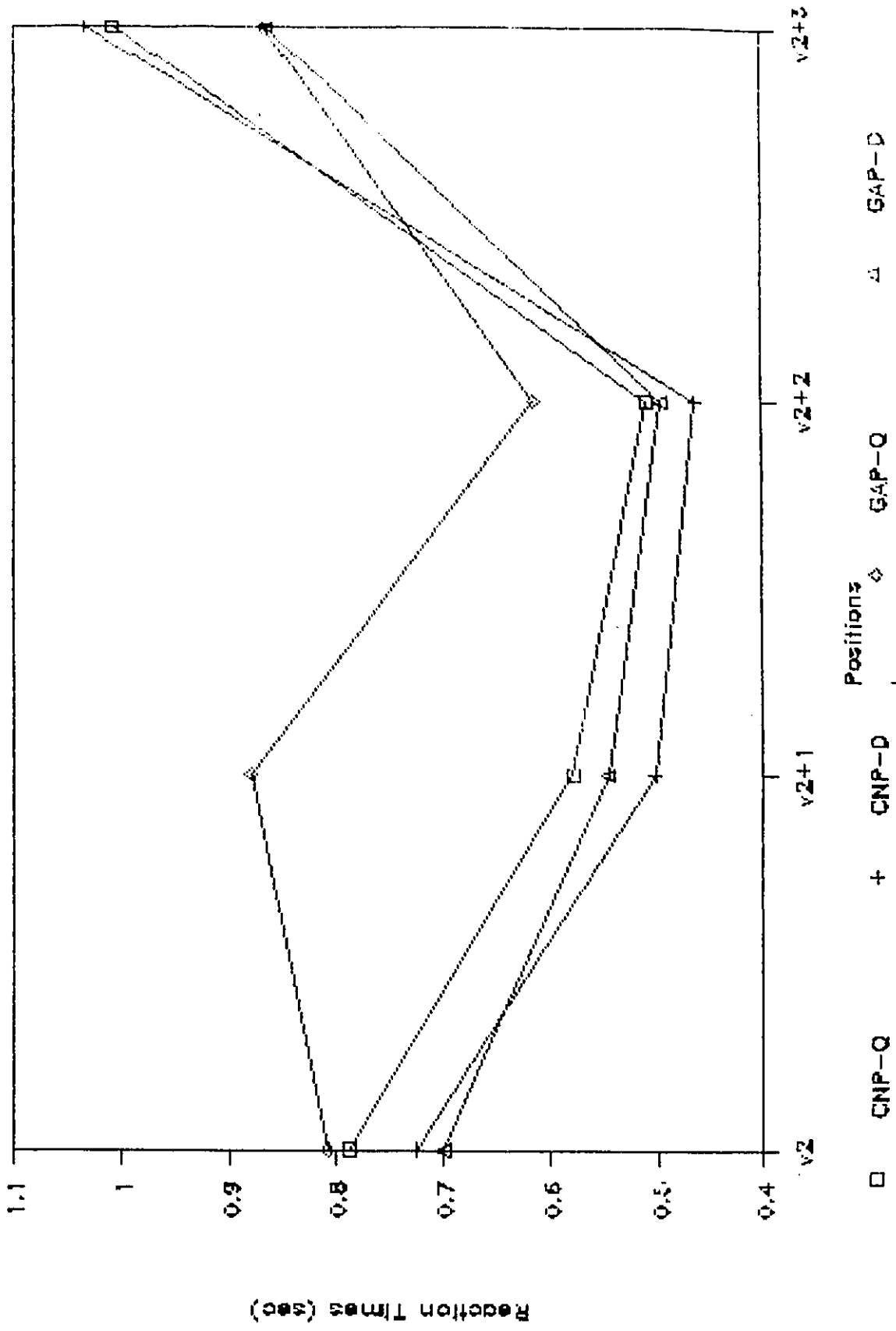
	v^2	v^{2+1}	v^{2+2}	v^{2+3}
CNP-Q	789	579	510	1008
GAP-Q	809	880	615	867
CNP-D	726	502	464	1034
GAP-D	701	546	497	865

Mean Reaction Times in msec

(INSERT FIGURE 1 ABOUT HERE)

For the WH-questions, position v^{2+1} appears to be the critical position. At this position, the longest reaction times are for the GAP-Q condition (sentences such as 6b).

Figure 1
Mean RTs - CNP Island



Reaction times at that position are approximately 300 msec longer than reaction times in the CNP-Q condition (sentences such as 6a), and approximately 340-380 msec longer than either of the two declarative conditions. A similar pattern is found for V₂+2, although the difference is of a lesser magnitude. However, at V₂+3, we see a different pattern in which both the CNP conditions (Question and Declarative) are longer than both GAP conditions (Question and Declarative).

Table IV shows the results of the ANOVA by subjects and by items.

TABLE IV

	Structure		Type		Structure X type	
	by	by	by	by	by	by
	subj.	items	subj.	items	subj.	items
V ₂	0.00	0.00	3.78 ⁺	5.09 [*]	0.31	0.34
V ₂ +1	19.57 ^{**}	26.56 ^{**}	24.15 ^{**}	29.59 ^{**}	9.71 ^{**}	8.04 ^{**}
V ₂ +2	5.29 [*]	5.34 [*]	6.49 [*]	11.96 ^{**}	1.45	1.15
V ₂ +3	7.20 [*]	7.40 [*]	0.04	0.06	0.06	0.13

+ n.s. = p < 0.06

* = p < 0.05

** = p < 0.01

For both the by-subjects and by-items analyses, the V^2+1 position appears to be the locus of significant effects and of a significant interaction between Type and Structure.

A test of simple main effect reveals a significant effect of the variable Structure (GAP/CNP) only at position V^2+1 when the sentence is of the interrogative type, $F(1,3)=28.94$, $p=0.0001$, but no significant effect when it is of the declarative type.

4.4.2 The Potential end of the sentence issue

Here again, regular scores were used to compute an ANOVA analysis for the four first positions in sentences (6a) and (6e).

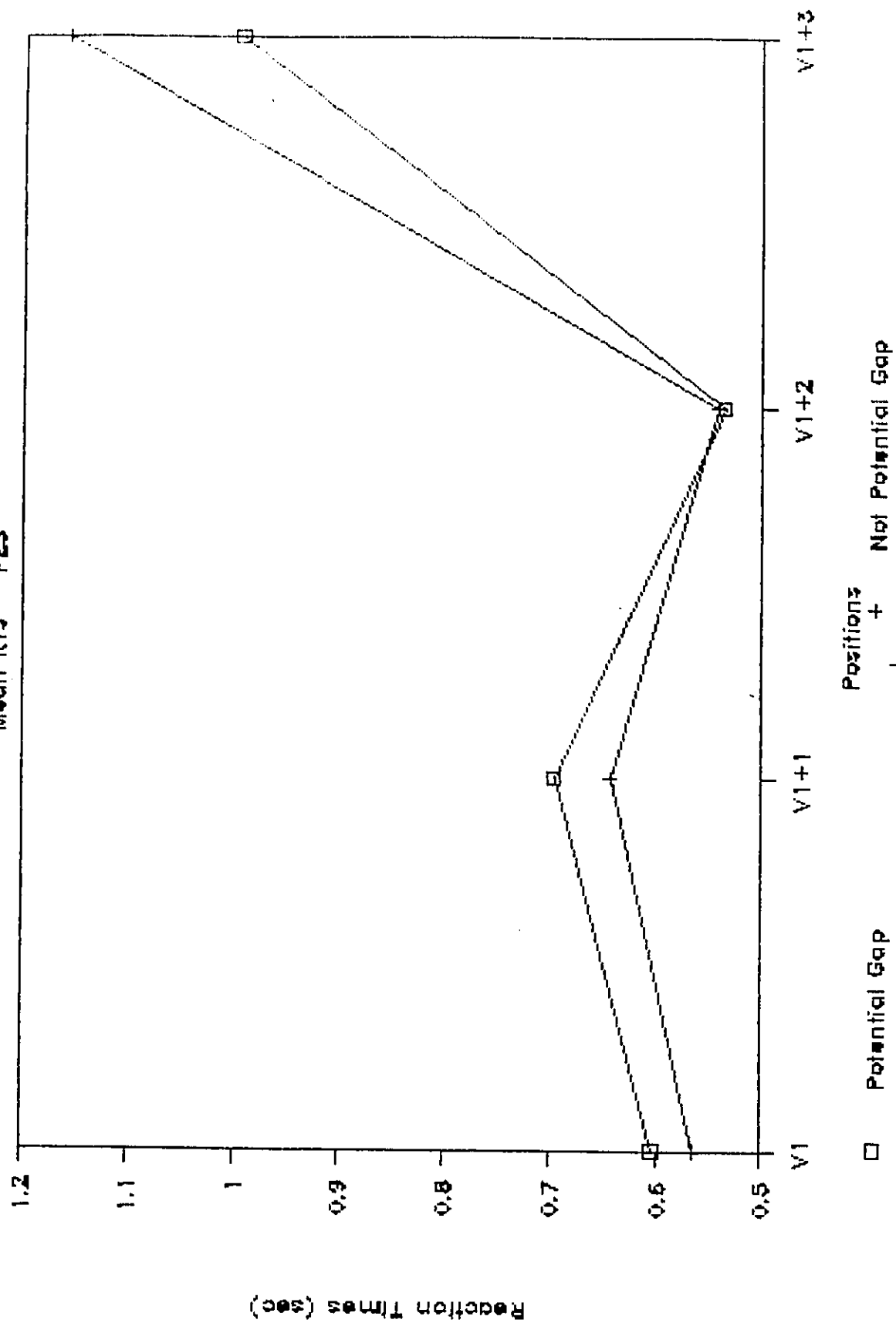
Table V

	V^1	V^1+1	V^1+2	V^1+3
Potential Gap location (6e)	604	696	536	995
Not Potential Gap location (6a)	566	643	543	1159

Mean Reaction Times by position

(INSERT FIGURE 2 ABOUT HERE)

Figure II
Mean RTs - PES



For this part of the experiment, the first three positions do not show a large difference in reaction times (less than 53 msec at the critical position). However, the fourth position shows a difference of 164 msec. A by-subjects and a by-items analysis were performed. The results are presented in Table VI. For both analyses, there was no significant effect at the first three positions ($F < 1$). At the last tested position, V^{1+3} , there was a significant effect of Structure, for subjects, $F(1,39)=4.55$, $p=0.0392$, and for items, $F(1,29)=4.48$, $p=0.0431$.

We used a repetition task to ensure that the subjects were paying attention to the self-paced reading task. As mentioned in the section describing the task, we recorded these repetitions and if a subject had less than 80% of good answers, the results were not kept for final analysis. Fortunately, we did not have to reject any subject on this ground. The coding of these results was done in the following fashion. If a sentence was repeated exactly as presented or if it was repeated with one word or more being replaced by synonyms, it was coded "correct", if it was repeated with at least one word missing, it was coded "incorrect". The results of these repetitions are presented in Table VI.

Table VI

Subjects	Correct (%)	Incorrect (%)
1	97	3
2	91	9
3	86	14
4	83	17
5	80	20
6	80	20
7	94	6
8	80	20
9	100	-
10	80	20
12	83	17
13	91	9
14	91	9
15	94	6
16	91	9
17	89	11
18	80	20
19	80	20
20	97	3
21	83	17
22	94	6
23	89	11
24	80	20
26	80	20
27	97	3
28	94	6
29	89	11
31	80	20
34	97	3
36	97	3
37	100	-
38	89	11
39	100	-
40	97	3
41	94	6
42	94	6
43	97	3
44	97	3
47	97	3
50	94	6
51	83	17

Repetition task rate of success in percentage

4.5 Summary

This chapter presented current research on a much debated question: What kind of grammatical information is immediately accessible to the parsing mechanism on its initial analysis of a sentence. This question is in fact very complex since it may determine if a model of processing mechanism is of a modular nature, in terms of Clifton & Frazier (1986; 1989), or whether it has a more monolithic nature, in terms of Crain and Fodor (1985).

The experiment described in this chapter was performed with constructions with an island, the Complex NP Island. The aim of this experiment was to verify if results obtained by Stowe (1984; 1986) with constructions with a Subject Island condition could be generalizable to other types of island. The experiment also investigated the possibility of explaining the false gap effect in terms of a potential end of the sentence effect.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.0 Introduction

This chapter will examine and discuss the experimental data in view of issues currently being debated in the field: the possibility of a sequence effect in the accessibility of grammatical knowledge to the processing mechanism, and in more general terms, the potentiality of modularity of the syntactic comprehension mechanism.

5.1 Interpretation of Experimental Results

The experiment presented in the previous chapter addressed mainly two issues. First, following Stowe (1984), it questions whether island knowledge is available immediately on-line for computing the analysis of a syntactic structure. It also asks whether the parsing mechanism postulates a gap in any potential location or whether it waits for information indicating a potential end of the sentence before making any prediction about the presence of a gap.

5.1.1 Islandhood Knowledge

We will first examine the question concerning islandhood knowledge. We have seen that islands represent structures out of which it is impossible or ungrammatical

to extract any constituent. The notion of island, in most instances, is closely related to the subjacency condition presented in chapter 2. Therefore, if the parser has direct, immediate access to islandhood knowledge, it follows that in a parsing model described within the framework of generative grammar, it has access on-line to a type of grammatical information which is richer than the information provided by phrase structure rules¹ and purely lexical information.

As mentioned in an earlier chapter, there are two primary studies which investigated processing of island constructions. Freedman and Forster (1985) propose that island constraints are not available to the syntactic processing mechanism, that these constraints go unnoticed by the parser. Clifton and Frazier (1989), even though their results are not statistically significant, interpret their findings as a hint that the parser does not notice island constructions in assigning gaps. Taking the opposing view, Stowe (1984; 1986) suggest that the parsing mechanism has access on-line to grammatical constraints. However, as she herself mentioned, her results are equivocal since she also found an asymmetry between gap location procedures for gaps in subject and object positions.

¹ However, this is not true for all parsing models. In a Generalized Phrase Structure Grammar (GPSG) this type of information is potentially sufficient.

In the experiment described in chapter 4, we compare wh-questions with potential gaps in object position, repeated in (1) below, to investigate access by the parsing mechanism to islandhood knowledge, in particular to the Complex Noun Phrase Island Constraint.

- (1) a. Avec qui le voisin a-t-il dit à [CNP
la petite fille qui jouait avec son
amie] que sa mère est partie vers
trois heures? (CNP-Q)
- b. Avec qui le voisin a-t-il dit que la
petite fille jouait avec son amie qui
est partie vers trois heures? (GAP-Q)

We were mainly interested by the positions after the verb jouait, and in particular after the preposition avec. If the parser postulates a gap in any potential gap location, without attention to island information, a false gap effect should be indicated by longer reaction times in both sentences (1a) and (1b) at the position avec than in non-question constructions. On the other hand, if the parser postulates gaps only where it is grammatical for them to appear, as suggested by Crain and Fodor (1985), or in other words, if the parser has direct access to islandhood knowledge, we should expect a difference in reaction times between these two sentences; the island construction taking less time to process than the gap construction.

Our results indicate a significant difference in reaction times at the preposition location between the

CNP-Q and the GAP-Q sentences. The CNP-Q appears to take 300 msec less than the GAP-Q at the preposition location. This result can therefore be taken as evidence that CNP-Q sentences are easier to process than GAP-Q constructions. In the CNP-Q sentence, the parsing mechanism does not expect to locate a gap after jouait since it is entering an island, and is thus not surprised by the presence of the prepositional phrase avec son amie. In the GAP-Q sentence a false gap effect is noted: the parsing mechanism expects a gap after jouait and encounters the prepositional phrase avec son amie creating a "surprise" effect which leads to longer reaction times for this section of the sentence. Of primary interest to our experiment was the comparison between CNP-Q and CNP-D at the critical position V^2+1 , the prepositional phrase after jouait, the difference between these two types of sentences is not statistically significant, only 77 msec, in comparison to reaction times for GAP-Q and GAP-D constructions where the average for GAP-Q constructions is 334 msec longer than for GAP-D as described earlier. This significant difference in mean reaction times between the GAP-constructions (334 msec) versus the CNP-sentences (77 msec) can be taken as evidence that the parsing mechanism does not expect a gap to appear within the Complex NP island. These results are compatible with the view that the parsing mechanism has direct access to islandhood

knowledge (here to the Complex NP Constraint) as proposed by Stowe (1984) on the basis of her results.

5.1.2 Potential End of the Sentence

The second issue investigated was the role of a potential end of the sentence in determining gap location. We wanted to verify if the parsing mechanism associates a filler with the first potential gap location it can find independently of the fact that this position is or not a potential end of the sentence. We compared sentences such as those presented in (2).

- (2) a. Avec qui le voisin a-t-il dit à la petite fille que sa mère est partie vers trois heures?

(With whom did the neighbor tell the little girl that her mother left around three o'clock?)

- b. A qui le voisin a-t-il dit à la petite fille que sa mère avait parlé avant de partir?

(To whom did the neighbor tell the little girl that her mother was talking just before leaving?)

In the matrix clause of (2a), the position after dit is not to be considered as a potential gap location since the verb dire does not take an avec qui complement. The prepositional (V^{1+1}) position should not show an increase in reaction times since the parsing mechanism based on lexical information will not expect a gap to appear at that position. In (2b), however, the V^{1+1} position can be

considered as a potential gap location since dire does subcategorize for an à qui complement. This position should demonstrate a false gap effect when the parsing mechanism notices the presence of à la petite fille.

In comparing sentences such as (2a) and (2b), our results indicate no difference in reaction times in the position immediately following the verb in the matrix clause. This can be interpreted as evidence that the parsing mechanism is not surprised by the prepositional phrase à la petite fille in (2b) as hypothesized, and thus, that it does not expect a gap to appear in that position.

In all of the sentences used in our experiment, the only context in which we get a "surprise" effect is when the potential gap location corresponds to a potential end of the sentence, and nowhere else. Thus, there seems to exist an ambiguity between false gap effect and the notion of potential end of the sentence, implying that this notion should be considered as a potential parameter in determining gap locations.

Returning to the results for the Island sentences, it would seem that they can be interpreted as an indication that the parsing mechanism would not postulate a gap within the Complex NP island, not because it is within an island, but because in our experimental sentences the target position does not represent a potential end of the

sentence. Therefore, at this point, it would appear that the results obtained with island constraint constructions are confounded with those of the potential end of the sentence. Because the critical position in our experiment did not constitute a potential end of the sentence, the parser would not expect a gap to appear and thus, no false gap filling effect would be recorded.

As mentioned in chapter 4, not all native speakers accept the double avec-phrases. Therefore, another interpretation can be given to the difference in reaction times between sentences (1a) and (1b). One can interpret the longer reaction times at the preposition avec in sentence (1b) as an effect of ungrammaticality². The position being already filled, the filler cannot be unloaded in that position, and the subject would be left with a filler without a landing site. If this is so, this only provides evidence in support of the thesis that islandhood knowledge is available on-line since no such effect is noted in sentence (1a) at the corresponding position. On the other hand, if we consider sentences such as (1b) to be grammatical, the potential end of the

² This option does not seem to have been taken by our subjects. In processing ungrammatical sentences, one would expect a steady increase of processing difficulty starting at the point where agrammaticality is noticed by the subject. Our results indicate no such effect: there is a sharp increase at the preposition position in sentence (1b) but the following positions show a decrease in reaction times which is not typical of processing difficulty.

sentence effect shows the limitation of the interpretation of islandhood knowledge as the parameter responsible for the non postulation of a gap inside the Complex NP island. In any case, these two interpretations are compatible with the view that grammatical information is readily available, not to filter, but to guide the parser in its decision taking during sentence processing.

Future research is needed to separate end of the sentence and island knowledge effects. Although in this experiment, Complex NP clauses did not constitute a potential end of the sentence, it is possible to come up with structures where they do correspond to a potential end of the sentence (see for example sentence (6b) in the previous chapter). For the sake of presentation, the following set of sentences in (3) demonstrates that the potential end of the sentence effect and the island constraint effect are two distinct issues. The sentences following in (3) are a modification of similar sentences proposed in English by Otsu (1981) and by Goodluck, Foley and Sedivy (in preparation).

- (3) a. Avec quoi le garçon a-t-il vu l'homme qui peindrait la maison?

With what did the boy see [the man who was painting the house] ___ ?

- b. Avec quoi le garçon a-t-il vu l'homme peindre la maison?

With what did the boy see [the man paint the house ___]?

In sentence (3a), the Complex NP clause constitutes the end of the sentence. If gap location procedures are restricted to points that are potential end of the sentence, then the parser can postulate a gap at the end of the relative clause in (3a). However, this would lead to an ungrammatical sentence. The filler Avec quoi cannot be linked to the verb peinturait since it is situated within the Complex NP island which does not allow extraction. In sentence (3b), Avec quoi can be associated with the verb peinturait since this verb is not located within an island and the object position can be considered as an extraction site. This comparison set indicates one way in which island knowledge effects can be separated from potential end of the sentence effects. However, there is no way at this point to distinguish between a processing model where islandhood knowledge is used on-line and a model where island constraints are consulted only after the end of the sentence has been reached.

According to Clifton and Frazier (1989), there is intuitive evidence suggesting that within the same clause the Active Filler strategy³ will predict that the parsing mechanism will identify the first available position as the correct gap location. Therefore, they propose that in

³ The Active Filler strategy is described in (18) in chapter 3.

sentences such as (4a), the preferred reading should be (4c) and not (4b).

- (4) a. Who did Fred tell Mary left the country?
 b. Who_i did Fred tell Mary ____i left the country?
 c. Who_i did Fred tell ____i Mary left the country?

(Clifton and Frazier 1987:292)

The Active Filler strategy indicates that the parser will prefer the gap analysis over an overt noun phrase. This implies that in such sentences the parsing mechanism should be surprised by the presence of Mary in the above example. Our results, however, do not support Clifton and Frazier (1987)'s prediction. In our comparison between (2a) and (2b), reproduced in (5, for ease of presentation, there is an indication that the parser prefers the overt noun phrase analysis over the gap analysis. In (5b) where we should get a false gap effect according to Clifton and Frazier (1987), we do not get a difference in reaction times compared to (5a) where no gap filling is possible after dit.

- (5) a. Avec qui le voisin a-t-il dit à la petite fille que sa mère est partie vers trois heures?

(With whom did the neighbor tell the little girl that her mother left around three o'clock?)

- b. A qui le voisin a-t-il dit à la petite fille que sa mère avait parlé avant de partir?

(To whom did the neighbor tell the little girl that her mother was talking just before leaving?)

We propose that this preference for the overt noun phrase analysis after dit is due to the fact that this position does not represent a potential end of the sentence⁴, and that the parsing mechanism does not postulate a gap in such a context on its initial parse through the sentence.

On the basis of the results presented in chapter 4, we propose that the parser will use a Gap as a First Resort strategy in cases where there is a potential end of the sentence and that it will adopt a Gap as a Second Resort strategy in other cases. This implies that the Active Filler Strategy as proposed by Clifton and Frazier (1989) is not as general as claimed, and that the notion of potential end of the sentence can be considered as a good predictor for finding gap locations.

5.1.3 Wh-constructions vs declaratives

Crain and Fodor (1985) and Stowe (1984; 1986) both

⁴ Again, as mentioned in chapter 3, sentences such as:

- a. Jean a dit à Paul.
b. A qui a-t-il dit?
are not grammatical sentences.

found that WH-constructions take longer to process than their corresponding declarative constructions. This conclusion is borne out by our results which indicate that for each of the four examined positions, the mean reaction times are longer for the question version than they are for the declarative one.

As noted above, there was no significant difference between CNP-Q and CNP-D versions at the critical position v^{2+1} . There was, however, a significant difference in reaction times between the CNP-versions at position v^{1+3} . Aaronson and Scarborough (1976) found that in a self-paced reading task, reaction times gradually increase over a phrase followed by a decrease to shorter reaction times after a syntactic boundary. However, an effect of the same magnitude is not noted in the GAP-versions. In these constructions there is an increase in mean reaction times but it is not as great as in the CNP-constructions. One potential explanation can be that the parsing mechanism has to keep in memory the filler while it is going through the Complex NP island in order to unload it in the next embedded sentence. This longer retention of the filler could be the source of the longer reaction times in the CNP-constructions.

5.2 Methodological issues

As described in the methodology chapter, we used a self-paced reading task. This task has been used by many

researchers over the years, and as any experimental task has its drawbacks. However, we feel that it is a worthwhile alternative to sophisticated technologies such as the eye-fixation paradigm used by Frazier and Rayner (1982), or the evoked brain potentials used by Garnsey, Tanenhaus and Chapman (1989). The self-paced reading task allows measures for each word or group of words, and it is sensitive to differences between positions within a sentence, contrary to more global measures such as grammaticality judgments. Moreover, it has the advantage of being an on-line task contrary to other tasks such as, for example, the matching task used in Freedman and Forster (1985).

However, the self-paced reading task does not reveal anything if it is used by itself. It is a tedious task from the point of view of the subjects and one needs a supplementary task to keep the subjects' attention in order to insure that they are in fact reading the proposed sentences on the screen. Researchers have used it with different subordinate tasks: 1) memorization: Aaronson and Scarborough (1976), Stowe (1984), Tanenhaus, Boland, Garnsey and Carlson (1989); 2) question answering: Aaronson and Scarborough (1976); 3) Paraphrasing: Pynte (1978); 4) grammaticality judgement task: Crain and Fodor (1985), Clifton and Frazier (1989).

In a pilot study, we used the self-paced reading task

in conjunction with comprehension questions. After reading a sentence, a yes/no question appeared on the screen and the subjects were asked to press the button corresponding to the appropriate answer. We did not get any significant results with this subordinate task. Reading times were very fast, in most instances below 100 msec. The ratio of success for the yes/no questions was less than 40%, indicating that the subjects were not reading the sentences for comprehension and that they were only guessing the answer to the comprehension questions. We decided to use as a secondary task to the self-paced reading task verbatim recall. This task requires the full attention of the subjects since they have to repeat the sentences in front of the research assistant who will immediately know if they are paying attention or not. As described in chapter 4, the rate of success of this secondary task was far superior to the question answering task, around 80%. This indicates that if one decides to use the self-paced reading task careful attention should be paid to the selection of the subordinate task. In accord with Stowe (1984), we feel that the contrasts we obtained between conditions in our experiment support the view that the self-paced reading task is sensitive to sentential environment, which entails differences in immediate local processing.

However, as mentioned in Garnham (1989), a

methodological caution should be raised. He argues that self-paced reading experiments can be used to investigate both task-specific processing and fundamental comprehension processes, but he suggests that it can no longer be assumed that single experiments answer questions about fundamental processes; these can only be reflected in patterns of results that are constant across a variety of tasks.

5.3 Modularity

One of the major aims of research in psycholinguistics is to determine the type of organization of the mental grammar. Many proposals exist, for example, Government and Binding model, Lexical Functional Grammar, Generalized Phrase Structure Grammar, Relational Grammar. The two models in which most experimental work on filler-gap dependencies has been done are Chomsky's Government and Binding (transformational) approach, and the Generalized Phrase Structure Grammar (non-transformational) approach. The model of grammar proposed by Chomsky (1981; 1986) is organized according to a modularity approach while the Generalized Phrase Structure Grammar (GPSG) has possibly a more monolithic view of syntactic operations. Since there exists a certain relationship between the syntactic processing mechanism and Grammar, the choice of a theoretical model for

language representation will influence the image one has of the processing mechanism. One of the dominant issues in psycholinguistics is to determine whether the language processing system has a modular architecture or not. In other words, the question is to discover how the notion of modularity in knowledge representation may affect natural language processing.

5.3.1 Modularity in Language Processing

The notion of modularity is well accepted in all current linguistic theories. However, different theories have different definitions of what a module is and what type of information it contains, as well as the number of modules that exist (c.f. Tanenhaus, Carlson and Seidenberg 1985; Fodor 1988).

A number of studies (among others, Forster and Olbrei 1973; Frazier 1979, 1987; Forster 1979; Ferreira and Clifton 1986) assume that the language comprehension system contains modules that operate in an autonomous fashion and which correspond to different linguistic levels. Moreover, such studies provide evidence that there exists a syntactic processing module which initially constructs a syntactic analysis without consulting any other sources of knowledge such as semantic or pragmatic

information⁵. As Ferreira and Clifton (1986) point out, it is important to make a distinction between "initial" and "eventual" use of non-syntactic information. The modular approach assumes that non-syntactic information is not used by the the parser on its initial parse, but it does not reject its contribution in language processing. Rather, it simply implies that such information could be used after the initial syntactic representation has been completed.

In the field of sentence comprehension, the notion of modularity within the syntactic processing component is also being debated and no consensus seems to have yet emerged. Different positions about modularity of the syntactic processing mechanism can be found in the literature. Many researchers, for example, Forster (1979), Clifton and Ferreira (1987), and Frazier (1987) claim that there is a grammatical processing system with modular subcomponents, including a lexical processing module, one or several distinct syntactic processing modules. The general claim within such an approach is that the Phrase Structure component constitutes a module⁶ including phrase

⁵ This is not the only position found in the literature, Tyler and Marslen-Wilson (1977) and Marslen-Wilson and Tyler (1980), suggest that there exists an interactive approach where information from different sources can be used in the initial analysis.

⁶ Clifton and Ferreira (1987:277) define a module as "a distinct information processing element, a tightly constrained system of a small number of elementary

structure rules' information. This module is used in the initial analysis and makes this analysis available to the other module(s) in subsequent analyses (i.e. there is an order in rule application).

In recent studies (Tanenhaus, Carlson, Trueswell 1990; Boland, Tanenhaus, Carlson, Garnsey 1989), the question of whether the processing mechanism postulates gaps on the basis of thematic information has been raised. This implies that the lexical information used by the parser on its initial analysis contains not only subcategorization information but also a set of thematic roles which can define possible gap locations.

Frazier, Clifton and Randall (1983) take as evidence for internal modularity of the syntactic processing mechanism that some grammatical information, such as control information and possibly grammatical constraints, are delayed in sentence comprehension, and therefore may constitute modules. Another possible module which is often postulated in the literature (e.g. Weinberg 1987) is a module where binding relations⁷ are established by the parser. The challenge of such a position is to establish

processes operating on representations phrased in a constrained and partially specialized vocabulary". Each module is said to operate in an autonomous fashion with some limited but necessary intercommunication among modules.

⁷ The operation by which Noun Phrases (NP) are interpreted as coreferential or not.

methodologies which will allow to distinguish the different modules, i.e. methodologies that will be able to pinpoint the output of each modules.

The other major position about modularity of the syntactic processing mechanism is the one taken by Crain and Fodor (1985) which assumes that there is a single syntactic processing module implying that all sorts of grammatical information are readily and immediately available to the parser. They provide evidence showing that control information is used on-line contrary to what Frazier et al. (1983) propose. Moreover, Stowe (1984; 1986) provides evidence compatible with the view that islandhood knowledge is available in the initial analysis.

The results obtained in the experiment described in chapter 4 are consistent with the view that grammatical constraints such as the Complex NP Constraint are accessible on-line, as suggested by Stowe (1984; 1986). This could be taken as evidence against the Modular approach, however, one can also postulate that different modules may operate simultaneously. The question is very complicated; evidence showing that more than one type of grammatical information is accessed on-line by the parsing mechanism does not indicate clearly and without any doubt that modularity does not exist since it can be interpreted as the result of modules acting simultaneously. Unfortunately, the potential end of the sentence results

do not allow us to provide strong evidence for or against such a position and the ambiguity remains. From our results, the only thing that can be said at this point is that the Complex NP Constraint seems to be readily accessible to the processing mechanism.

To summarize, one view postulates that the parsing mechanism can be defined as having a modular structure similar to the one postulated for the syntactic component by Chomsky's Government and Binding model, i.e it has a Phrase Structure module which provides lexical information, and possibly other modules which contribute information about control, constraints, etc., and there is at least the possibility of another module which supply binding information. The other position assumes that there is only one syntactic processing module which encompasses all of the grammatical information necessary to process a sentence. Our results do not provide evidence strong enough to clarify the ambiguity that exists in experimental data provided by different researchers in the field.

5.4 Conclusion and Implications for Future Research

This research has focused on the syntactic processing of filler-gap sentences, more specifically of the relative construction which constitutes an island. The status of island constructions in processing is still questioned

(c.f. Fodor, to appear) and one of the aims of this dissertation was to resolve the ambiguity found in the literature. This study has provided experimental evidence consistent with Stowe (1984)'s island results. Stowe (1984) did not get a gap-non-location effect in subject position. Our results have demonstrated that a gap-non-location effect was not found either within a Complex NP island in object position.

This experiment also has shown that the notion of Potential End of the Sentence is a factor to be considered in gap location detection. Data supporting false-gap filling is frequently also compatible with the view that gaps are filled only at a potential end of the sentence. More research is needed to untangle the ambiguity between the potential end of the sentence and the island effects in our results. Material should be developed to show that these effects are independent of one another. In spite of the ambiguity, we feel that the potential end of the sentence effect is an important issue which is worth pursuing in the future. Moreover, the potential end of the sentence effect shows that the Active Filler strategy proposed by Frazier (1987) will need to be more specifically defined taking into consideration the fact that the parser does not always prefer the gap option over an overt noun phrase, for example in sentences such as (5).

Further investigation will be needed in order to define more specifically the notion of Potential End of the Sentence. This effect may be more exaggerated with a self-paced reading task but may also be seen in other tasks. Careful attention should be given in the construction of experimental material considering this effect.

This dissertation has provided experimental data in processing a language other than English. Cross-linguistic data are important for a better understanding of syntactic processing. Cross-linguistic data can show, for example, if processing principles identified to date, for example Frazier's Minimal Attachment and Late Closure, are modulated by language specific characteristics or if they can be applied universally (e.g. Frazier 1987; Mitchell, to appear).

There exists literature on the application of a parsing model to French but it is largely based on intuitive evidence (c.f. Wherli 1983, 1987). More experimental evidence is needed to establish the exact processing principles used in French and in other languages.

Psycholinguistic research has been concerned with filler-gap dependencies in English, but very few studies have tried to determine if these relationships are established in similar ways in other languages. For

example, in French, dependencies between gaps and fillers can be considered in some instances to be longer than in English, since French seems to violate subadjacency (c.f. Sportiche 1981). Also, there are important cross-linguistic differences in island constraints that could be addressed in French, for example the difference in bounding nodes between French (NP and S') and English (NP and S) (c.f. Sportiche 1981). One can question if this difference affects the processing mechanism and if so, how. Mitchell (to appear) has shown that even simple replication in processing studies in another language can be difficult and can be affected by abstract syntactic variables.

Some interesting research has started to emerge on parsing of Romance languages, for example, on Italian (De Vincenzi 1988), on Spanish (Cuetos and Mitchell 1989), on Spanish and French (Mitchell (to appear)). But still further research is needed in order to look at languages other than English for potential answers about the functioning and possible architecture of the parsing mechanism.

Examining if and how cross-linguistic differences influence the description and the functioning of the parsing mechanism seems to be the way to investigate if there is a universal parsing mechanism, and if so, what are its characteristics.

APPENDIX I

EXPERIMENTAL SENTENCES

1a. Avec qui le voisin a-t-il dit à la petite fille qui jouait avec son amie que sa mère était partie vers trois heures?

1b. Avec qui le voisin a-t-il dit que la petite fille jouait avec son amie qui est partie vers trois heures?

1c. A qui le voisin a-t-il dit à la petite fille que son amie avait parlé avant de partir?

1d. Le voisin a dit à la petite fille qui jouait avec son amie que sa mère était partie vers trois heures.

1e. Le voisin a dit que la petite fille jouait avec son amie qui est partie vers trois heures.

2a. Avec qui l'avocat a-t-il affirmé à son client qui complotait avec les russes qu'il négocierait le contrat de vente d'armes?

2b. Avec qui l'avocat a-t-il affirmé que son client complotait avec les russes qui négocierait le contrat de vente d'armes?

2c. A qui l'avocat a-t-il affirmé à son client qu'il parlerait de la vente d'armes?

2d. L'avocat a affirmé à son client qui complotait avec les russes qu'il négocierait le contrat de vente d'armes.

2e. L'avocat a affirmé que son client complotait avec les russes qui négocierait le contrat de vente d'armes.

3a. Avec qui a-t-on dit à la monitrice qui voyagera avec les enfants qu'elle pourra partir demain?

3b. Avec qui a-t-on dit que la monitrice voyagera avec les enfants qui pourront partir demain?

3c. A qui a-t-on dit à la monitrice qu'elle devra s'adresser en cas de besoin?

3d. On a dit à la monitrice qui voyagera avec les enfants qu'elle pourra partir demain.

- 3e. On a dit que la monitrice voyagera avec les enfants qui pourront partir demain.
- 4a. Avec qui l'homme a-t-il dit à sa femme qui skiait avec les enfants que le moniteur participera à une compétition demain?
- 4b. Avec qui l'homme a-t-il dit que sa femme skiait avec les enfants qui participeront à une compétition demain?
- 4c. A qui l'homme a-t-il dit à sa femme que les enfants avaient demandé de participer à la compétition demain?
- 4d. L'homme a dit à sa femme qui skiait avec les enfants que le moniteur participera à une compétition demain.
- 4e. L'homme a dit que sa femme skiait avec les enfants qui participeront à une compétition demain.
- 5a. Avec qui a-t-on dit à la petite fille qui s'amusait avec ses amis que ses parents partiront en voyage demain?
- 5b. Avec qui a-t-on dit que la petite fille s'amusait avec ses amis qui partiront en voyage demain?
- 5c. A qui a-t-on dit à la petite fille que ses parents rapporteraient des cadeaux de leur voyage?
- 5d. On a dit à la petite fille qui s'amusait avec ses amis que ses parents partiront en voyage demain.
- 5e. On a dit que la petite fille s'amusait avec ses amis qui partiront en voyage demain.
- 6a. Avec qui as-tu dit à ta tante qui t'invitait avec tes parents que tu lui rendrais visite la semaine prochaine?
- 6b. Avec qui as-tu dit que ta tante t'inviterait avec tes parents qui lui rendraient visite la semaine prochaine?
- 6c. A qui as-tu dit à ta tante que tes parents rendraient visite la semaine prochaine?
- 6d. Tu as dit à ta tante qui t'invitait avec tes parents que tu lui rendrais visite la semaine prochaine.
- 6e. Tu as dit que ta tante t'invitait avec tes parents qui lui rendraient visite la semaine prochaine.

7a. Avec qui a-t-on promis à la dame qui chantait avec le groupe que l'orchestre signera un contrat prochainement?

7b. Avec qui a-t-on promis que la dame chanterait avec le groupe qui signera un contrat prochainement?

7c. A qui a-t-on promis à la dame que le groupe chantera cette nouvelle chanson?

7d. On a promis à la dame qui chantait avec le groupe que l'orchestre signera un contrat prochainement.

7e. On a promis que la dame chanterait avec le groupe qui signera un contrat prochainement.

8a. Avec qui a-t-il dit à son amie qui vivait avec ses parents qu'il déménageait à Montréal le mois prochain?

8b. Avec qui a-t-il dit que son amie vivait avec ses parents qui déménagent à Montréal le mois prochain?

8c. A qui a-t-il dit à son amie que ses parents vendaient la maison familiale le mois prochain?

8d. Il a dit à son amie qui vivait avec ses parents qu'il déménageait à Montréal le mois prochain.

8e. Il a dit que son amie vivait avec ses parents qui déménagent à Montréal le mois prochain.

9a. Avec qui as-tu dit à la bénévoles qui travaillait avec les jeunes que tu organiserais un voyage à l'été?

9b. Avec qui as-tu dit que la bénévoles travaillait avec les jeunes qui organisent un voyage à l'été?

9c. A qui as-tu dit à la bénévoles que tu t'adresserais pour le voyage à l'été?

9d. Tu as dit à la bénévoles qui travaillait avec les jeunes que tu organiserais un voyage à l'été.

9e. Tu as dit que la bénévoles travaillait avec les jeunes qui organisaient un voyage à l'été.

10a. Avec qui as-tu annoncé à la thérapeute qui travaille avec les gens que nous essaierons les nouveaux exercices?

10b. Avec qui as-tu annoncé que la thérapeute travaille avec les gens qui essaieront les nouveaux exercices?

10c. A qui as-tu annoncé à la thérapeute qu'elle enseignerait les nouveaux exercices?

10d. Tu as annoncé à la thérapeute qui travaille avec les gens que nous essaierons les nouveaux exercices.

10e. Tu as annoncé que la thérapeute travaille avec les gens qui essaieront les nouveaux exercices.

11a. Avec qui as-tu dit à ton amie qui sortait avec ses enfants que tu voulais aller au cinéma samedi soir?

11b. Avec qui as-tu dit que ton amie sortait avec ses enfants qui voulaient aller au cinéma samedi soir?

11c. A qui as-tu dit à ton amie que ses enfants parlaient de leurs problèmes?

11d. Tu as dit à ton amie qui sortait avec ses enfants que tu voulais aller au cinéma samedi soir.

11e. Tu as dit que ton amie sortait avec ses enfants qui voulaient aller au cinéma samedi soir.

12a. Avec qui a-t-on annoncé à la député qui manifestait avec les grévistes que la compagnie voulait conclure une entente hier soir?

12b. Avec qui a-t-on annoncé que la député manifestait avec les grévistes qui voulaient conclure une entente hier soir?

12c. A qui a-t-on annoncé à la député que les grévistes avaient accordé leurs votes hier soir?

12d. On a annoncé à la député qui manifestait avec les grévistes que la compagnie voulait conclure une entente hier soir.

12e. On a annoncé que la député manifestait avec les grévistes qui voulaient conclure une entente hier soir.

13a. Avec qui a-t-il dit à la femme qui dansait avec la troupe de ballet qu'elle devrait partir en tournée?

13b. Avec qui a-t-il dit que la femme dansait avec la troupe de ballet qui devait partir en tournée?

13c. A qui a-t-il dit à la femme que la troupe de ballet demanderait une nouvelle chorégraphie?

13d. Il a dit à la femme qui dansait avec la troupe de ballet qu'elle devrait partir en tournée.

13e. Il a dit que la femme dansait avec la troupe de ballet qui devait partir en tournée.

14a. Avec qui as-tu dit à ton frère qui s'entraînait avec son copain que tu voulais participer au prochain marathon?

14b. Avec qui as-tu dit que ton frère s'entraînait avec son copain qui voulait participer au prochain marathon?

14c. A qui as-tu dit à ton frère que son copain avait demandé des conseils pour son entraînement?

14d. Tu as dit à ton frère qui s'entraînait avec son copain que tu voulais participer au prochain marathon.

14e. Tu as dit que ton frère s'entraînait avec son copain qui voulait participer au prochain marathon.

15a. Avec qui as-tu dit à ton collègue qui discutait avec les chercheurs que tu travaillais au nouveau laboratoire?

15b. Avec qui as-tu dit que ton collègue discutait avec les chercheurs qui travaillaient au nouveau laboratoire?

15c. A qui as-tu dit à ton collègue que les chercheurs avaient envoyé leurs derniers résultats?

15d. Tu as dit à ton collègue qui discutait avec les chercheurs que tu travaillais au nouveau laboratoire.

15e. Tu as dit que ton collègue discutait avec les chercheurs qui travaillaient au nouveau laboratoire.

16a. Avec qui as-tu dit à ton cousin qui travaille avec ton copain que tu voulais réussir en affaires?

16b. Avec qui as-tu dit que ton cousin travaille avec ton copain qui veut réussir en affaires?

16c. A qui as-tu dit à ton cousin que ton copain attribuait son succès en affaires?

16d. Tu as dit à ton cousin qui travaille avec ton copain que tu voulais réussir en affaires.

16e. Tu as dit que ton cousin travaille avec ton copain qui veut réussir en affaires.

17a. Avec qui as-tu dit à ton mari qui soupait avec des clients que tu le rejoindrais au restaurant?

17b. Avec qui as-tu dit que ton mari soupait avec des clients qui le rejoindraient au restaurant?

17c. A qui as-tu dit à ton mari que tu avais promis un souper au restaurant?

17d. Tu as dit à ton mari qui soupait avec des clients que tu le rejoindrais au restaurant.

17e. Tu as dit que ton mari soupait avec des clients qui le rejoindraient au restaurant.

18a. Avec qui a-t-elle dit à ses parents qui partaient avec un groupe qu'elle referait le voyage?

18b. Avec qui a-t-elle dit que ses parents partaient avec un groupe qui refaisait le voyage?

18c. A qui a-t-elle dit à ses parents qu'elle offrait un voyage?

18d. Elle a dit à ses parents qui partaient avec un groupe qu'elle refaisait le voyage.

18e. Elle a dit que ses parents partaient avec un groupe qui refaisait le voyage.

19a. Avec qui ont-ils dit à leur ami qui travaille avec ses enfants qu'ils voulaient s'associer pour former une compagnie?

19b. Avec qui ont-ils dit que leur ami travaille avec ses enfants qui voulaient s'associer pour former une compagnie?

19c. A qui ont-ils dit à leur ami que ses enfants annonçaient la formation de leur compagnie?

19d. Ils ont dit à leur ami qui travaille avec ses enfants qu'ils voulaient s'associer pour former une compagnie.

19e. Ils ont dit que leur ami travaille avec ses enfants qui voulaient s'associer pour former une compagnie.

20a. Avec qui le père a-t-il dit à sa fille qui habitait avec sa mère qu'il lui rendrait visite une fois par semaine?

20b. Avec qui le père a-t-il dit que sa fille habitait avec sa mère qui lui rendait visite une fois par semaine?

20c. A qui le père a-t-il dit à sa fille qu'il rendait visite une fois par semaine?

20d. Le père a dit à sa fille qui habitait avec sa mère qu'il lui rendrait visite une fois par semaine.

20e. Le père a dit que sa fille habitait avec sa mère qui lui rendait visite une fois par semaine.

21a. Avec qui a-t-on annoncé à la ministre qui s'était entendu avec les employés que vous soutiendriez la position syndicale?

21b. Avec qui a-t-on annoncé que la ministre s'était entendu avec les employés qui soutenaient la position syndicale?

21c. A qui a-t-on annoncé à la ministre que les employés avaient réclamé de meilleures conditions de travail?

21d. On a annoncé à la ministre qui s'était entendu avec les employés que vous soutiendriez la position syndicale.

21e. On a annoncé que la ministre s'était entendu avec les employés qui soutenaient la position syndicale.

22a. Avec qui a-t-elle dit à la vendeuse qui négociait avec le client qu'elle voulait acheter cette maison?

22b. Avec qui a-t-elle dit que la vendeuse négociait avec le client qui voulait acheter cette maison?

22c. A qui a-t-elle dit à la vendeuse que le directeur devait confirmer la vente?

22d. Elle a dit à la vendeuse qui négociait avec le client qu'elle voulait acheter cette maison.

22e. Elle a dit que la vendeuse négociait avec le client qui voulait acheter cette maison.

23a. Avec qui a-t-on dit à la fille qui s'entraînait avec l'équipe nationale qu'elle irait aux Jeux Olympiques?

23b. Avec qui a-t-on dit que la fille s'entraînait avec l'équipe nationale qui irait aux Jeux Olympiques?

23c. A qui a-t-on dit à la fille que l'équipe nationale avait offert une place?

23d. On a dit à la fille qui s'entraînait avec l'équipe nationale qu'elle irait aux Jeux Olympiques.

23e. On a dit que la fille s'entraînait avec l'équipe nationale qui irait aux Jeux Olympiques.

24a. Avec qui as-tu dit à ta soeur qui avait été invitée avec ses amis que tu organisais un pique-nique?

24b. Avec qui as-tu dit que ta soeur avait été invitée avec ses amis qui organisaient un pique-nique?

24c. A qui as-tu dit à ta soeur que tu avais demandé d'organiser un pique-nique?

24d. Tu as dit à ta soeur qui avait été invitée avec ses amis que tu organisais un pique-nique.

24e. Tu as dit que ta soeur avait été invitée avec ses amis qui organisaient un pique-nique.

25a. Avec qui as-tu dit à tes élèves qui attendaient avec leurs parents que tu avais apporté tout le matériel de camping?

25b. Avec qui as-tu dit que tes élèves attendaient avec leurs parents qui avaient apporté tout le matériel de camping?

25c. A qui as-tu dit à tes élèves que leurs parents avaient permis de les amener en camping?

25d. Tu as dit à tes élèves qui attendaient avec leurs parents que tu avais apporté tout le matériel de camping.

25e. Tu as dit que tes élèves attendaient avec leurs parents qui avaient apporté tout le matériel de camping.

26a. Avec qui as-tu dit à ta mère qui sortait avec sa soeur que tu voulais aller au spectacle de danse?

26b. Avec qui as-tu dit que ta mère sortait avec sa soeur qui voulait aller au spectacle de danse?

26c. A qui as-tu dit à ta mère que tu as donné des billets pour le spectacle de danse?

26d. Tu as dit à ta mère qui sortait avec sa soeur que tu voulais aller au spectacle de danse.

26e. Tu as dit que ta mère sortait avec sa soeur qui voulait aller au spectacle de danse.

27a. Avec qui as-tu dit à la dame qui chantait avec le choeur que vous donnerez une série de concerts?

27b. Avec qui as-tu dit que la dame chantait avec le choeur qui donnera une série de concerts?

27c. A qui as-tu dit à la dame qu'elle doit demander les informations pour le concerts?

27d. Tu as dit à la dame qui chantait avec le choeur que vous donnerez une série de concerts.

27e. Tu as dit que la dame chantait avec le choeur qui donnera une série de concerts.

28a. Avec qui a-t-elle dit à sa mère qui partait avec ses amies qu'elle aime voyager?

28b. Avec qui a-t-elle dit que sa mère partait avec ses amies qui aiment voyager?

28c. A qui a-t-elle dit à sa mère que ses amies avaient payé le voyage?

28d. Elle a dit à sa mère qui partait avec ses amies qu'elle aime voyager.

28e. Elle a dit que sa mère partait avec ses amies qui aiment voyager.

29a. Avec qui as-tu dit à la candidate qui bavardait avec des électeurs que tu voulais discuter de son programme?

29b. Avec qui as-tu dit que la candidate bavardait avec des électeurs qui voulaient discuter de son programme?

29c. A qui as-tu dit à la candidate que tu enverrais son programme?

29d. Tu as dit à la candidate qui bavardait avec des électeurs que tu voulais discuter de son programme.

29e. Tu as dit que la candidate bavardait avec des électeurs qui voulaient discuter de son programme.

30a. Avec qui as-tu dit à ta soeur qui sort avec ses amis que tu préfères rester à la maison?

30b. Avec qui as-tu dit que ta soeur sort avec ses amis qui préfèrent rester à la maison?

30c. A qui as-tu dit à ta soeur que ses amis ont proposé une sortie?

30d. Tu as dit à ta soeur qui sort avec ses amis que tu préfères rester à la maison.

30e. Tu as dit que ta soeur sort avec ses amis qui préfèrent rester à la maison.

APPENDIX II
DESCRIPTIVE NORMS IN FRENCH

Several studies in language processing have shown the importance of lexical information in the comprehension of sentences, particularly of filler-gap constructions. Fodor's Lexical Expectation Hypothesis (1978) assumes that the sentence processor will first adopt the most frequent subcategorization frame for an item and it will postulate a gap if a specified phrase does not lexically appear in that position. Clifton, Frazier and Connine (1984) demonstrate the effects of violating a lexically based syntactic expectation. Their experiments provide support to the effect that lexical information about preferred subcategorization frames¹ is used very quickly during sentence processing. Their experiments also show that at least part of the lexical information (the rest being possibly pragmatic) used in sentence comprehension is information about the possible syntactic categories of the complement of the verb.

In order to establish descriptive norms for French verbs, a methodology similar to the one used by Connine et

¹ A verb can have more than one subcategorization frame. For example, the verb "chanter" (to sing) can take a direct object (NP), and indirect object (PP), or both. But when it is actually used, the preferred subcategorization frame appears to be [__ PP].

al. (1984) for English verbs was used. Two groups of University of Ottawa undergraduate students who were all native speakers of French were asked to participate in this study. The first group of 26 students received a list of 50 verbs, the second group of 25 received a similar list of also 50 verbs but with some verbs which did not appear on the first list; a total of 89 verbs were used. Each student received a test booklet in which each verb was typed at the left margin, followed by a setting. They were asked to write a sentence for each verb which would be likely in the specified setting. The settings used were: Home, Office, Downtown. A constant order was used and three different association of verb and setting were used. No time limit was imposed, but the students took an average of 30 minutes to perform this task. The resulting sentences were assigned according to the following series of syntactic frames which specifies the categories of the verbs' complements (adverbs and adverbial phrases were ignored in the scoring).

- | | |
|-----------------|---|
| 1. [Ø] | Pierre chante. |
| 2. [NP] | Pierre garde les enfants. |
| 3. [PP] | Pierre parle à ses enfants. |
| 4. [inf-S] | Pierre demande à partir. |
| 5. [qu-S] | Pierre dit qu'il chante pour les enfants. |
| 6. [NP] [PP] | Pierre donne des cadeaux à ses enfants. |
| 7. [NP] [inf-S] | J'ai vu Pierre partir. |
| 8. [PP] [qu-s] | Pierre lui demande ce qu'il veut. |
| 9. [PP] [inf-S] | Il lui demande de corriger ses devoirs. |
| 10. | use verb as a noun |
| 11. | passive |

12. no answer
13. other, unclassifiable

The results of this study are presented in percentage in Table VII.

Table VII

Percentages of Use of Each Verb in Each Syntactic Frames

	1	2	3	4	5	6	7	8	9	10	11	12	13
abandonner (1)	12	71	--	--	--	--	--	--	--	--	--	--	17
abandonner (2)	4	74	--	--	--	--	--	--	--	--	--	--	22
accepter (1)	--	35	--	45	15	--	--	--	--	--	--	5	--
accorder (2)	--	28	--	4	--	28	--	--	8	--	--	--	32
acheter (1)	--	85	--	--	--	11	--	--	--	--	--	4	--
acheter (2)	--	68	--	--	--	28	--	--	--	--	--	--	4
affirmer (2)	--	13	--	4	33	--	--	13	--	--	--	8	29
aider (1)	--	67	--	4	--	--	21	--	--	4	--	4	--
aider (2)	4	50	4	--	--	--	36	--	--	4	--	4	--
annoncer (2)	--	46	--	--	12	18	--	12	--	--	12	--	--
appeler (1)	4	92	--	--	--	--	--	--	--	--	4	--	--
apprendre (2)	8	44	4	32	4	4	--	--	4	--	--	--	--
approuver (1)	--	66	11	4	4	--	--	--	--	--	4	11	--
assigner (2)	--	12	--	--	--	58	--	--	4	--	22	--	4
attendre (1)	12	80	--	--	8	--	--	--	--	--	--	--	--
attérir (1)	88	--	--	--	--	--	--	--	--	--	--	4	8
battre (1)	--	20	--	--	--	--	--	--	--	--	--	--	80
boire (1)	19	77	--	--	--	--	--	--	--	--	--	4	--
boire (2)	36	60	--	4	--	--	--	--	--	--	--	--	--
bouger (1)	83	60	--	4	--	--	--	--	--	--	--	--	--
briser (2)	--	74	--	--	--	--	--	--	--	--	17	--	9
caler (2)	--	63	--	--	--	--	--	--	--	--	4	--	33
céder (2)	25	17	4	--	--	50	--	--	--	--	--	4	--
chanter (1)	88	8	4	--	--	--	--	--	--	--	--	--	--
chanter (2)	96	--	--	--	--	4	--	--	--	--	--	--	--
chercher (1)	4	84	8	--	--	--	--	--	--	--	--	--	4
choisir (1)	--	72	--	23	--	--	--	--	--	--	--	--	4
citer (2)	--	76	--	--	4	12	--	--	--	--	4	4	--
clarifier (2)	--	71	--	--	--	21	--	--	--	--	--	--	8
comprendre (1)	--	85	--	--	7	--	--	--	--	--	--	4	4
comprendre (2)	4	71	--	--	25	--	--	--	--	--	--	--	--
concéder (2)	9	19	9	9	--	45	--	--	--	--	--	9	--
conduire (1)	30	59	4	--	--	--	--	--	--	--	--	--	7
confier (2)	--	4	--	--	--	77	--	--	4	--	4	--	11

confirmer (2)	--	60	4	--	12	12	--	8	--	--	4	--	--
consacrer (2)	4	12	--	--	--	60	16	--	--	--	8	--	--
conseiller (2)	4	12	--	--	--	20	--	--	52	4	--	8	--
continuer (1)	12	16	--	60	4	--	--	--	--	--	--	4	--
courir (1)	92	--	--	4	--	--	--	--	--	--	--	4	--
courir (2)	77	--	--	19	--	--	--	--	--	4	--	--	--
débattre (1)	--	8	--	--	4	--	--	--	--	--	--	12	76
demander (1)	--	15	4	4	15	19	--	12	31	--	--	--	--
demander (2)	--	33	4	--	8	25	--	--	17	9	--	--	4
désobéir (1)	20	--	76	4	--	--	--	--	--	--	--	--	--
désobéir (2)	21	4	75	--	--	--	--	--	--	--	--	--	--
devoir (2)	--	4	--	80	--	4	--	--	--	8	--	4	--
dire (1)	--	4	--	--	4	19	--	23	42	--	--	4	4
dire (2)	--	4	4	8	32	4	--	20	24	--	--	4	13
divulguer (2)	4	44	--	--	--	26	--	--	--	--	--	26	--
donner (2)	--	35	--	--	--	65	--	--	--	--	--	--	--
douter (1)	--	--	24	12	48	--	--	--	--	4	--	--	12
douter (2)	--	4	40	8	36	--	--	--	--	4	--	--	8
échapper (1)	--	60	8	--	--	--	--	--	--	--	--	--	32
échapper (2)	--	42	25	--	--	--	--	--	--	--	--	--	33
écouter (1)	8	92	--	--	--	--	--	--	--	--	--	--	--
écouter (2)	4	92	--	--	--	--	--	--	--	--	--	4	--
écrire (1)	19	60	15	3	3	--	--	--	--	--	--	--	--
écrire (2)	28	36	16	--	--	8	--	--	--	4	--	8	--
enquêter (1)	15	27	34	8	--	--	--	--	--	12	--	4	--
enseigner (1)	48	20	16	4	--	4	--	--	8	--	--	--	--
enseigner (2)	17	42	--	--	--	25	--	8	--	4	--	4	--
entrer (1)	96	4	--	--	--	--	--	--	--	--	--	--	--
envoyer (2)	4	35	--	12	--	22	9	--	--	--	9	9	--
espérer (2)	--	--	--	60	36	--	--	--	--	--	--	4	--
essayer (1)	4	32	--	64	--	--	--	--	--	--	--	--	--
jouer (1)	37	--	59	--	--	--	--	--	--	--	--	4	--
lire (2)	28	64	--	--	--	--	--	--	--	--	--	8	--
manger (1)	56	44	--	--	--	--	--	--	--	--	--	--	--
obéir (1)	16	8	76	--	--	--	--	--	--	--	--	--	--
obéir (2)	--	--	96	--	--	--	--	--	--	--	--	4	--
offrir (2)	--	21	--	--	--	71	--	--	8	--	--	--	--
oublier (1)	--	88	--	12	--	--	--	--	--	--	--	--	--
parler (2)	40	8	44	--	--	--	--	--	--	--	--	4	4
partir (1)	89	--	--	11	--	--	--	--	--	--	--	--	--
payer (2)	12	50	8	--	--	22	4	--	--	--	4	--	--
permettre (1)	--	4	--	--	--	8	--	80	--	8	--	--	--
permettre (2)	--	--	--	--	--	16	--	8	68	4	4	--	--
plaire (2)	--	8	88	--	--	--	--	--	--	--	--	4	--
pleurer (1)	88	--	--	--	--	--	--	--	--	--	--	4	8
poser (2)	4	64	12	--	--	12	--	--	--	--	--	--	8
promettre (1)	--	--	--	44	4	12	--	4	8	--	--	4	--
promettre (2)	--	8	--	20	12	20	--	12	28	--	--	--	--
proposer (2)	--	16	--	8	4	36	--	--	32	--	--	4	--
quitter (1)	15	81	--	--	--	--	--	--	--	--	--	--	4
raconter (2)	--	46	--	--	--	42	--	4	--	--	--	8	--
recevoir (2)	4	92	--	--	--	--	--	--	--	--	4	--	--

réclamer (2)	--	80	00	8	4	--	--	--	--	--	8	--
refuser (1)	4	15	4	73	--	4	--	--	--	--	--	--
refuser (2)	--	32	4	56	--	--	--	8	--	--	--	--
regarder (1)	12	88	--	--	--	--	--	--	--	--	--	--
rendre (2)	--	12	4	--	8	--	--	--	--	--	--	--
répondre (1)	8	8	80	--	--	--	--	--	--	--	4	--
ressembler (2)	--	--	66	--	--	--	--	--	--	--	--	34
rire (2)	58	--	38	--	--	--	--	--	4	--	--	--
savoir (2)	--	13	--	16	71	--	--	--	--	--	--	--
songer (2)	4	--	58	34	--	--	--	--	--	--	4	--
se battre (1)	68	--	20	4	--	--	--	--	--	--	4	4
s'échapper (1)	88	--	--	4	--	--	--	--	--	--	4	4
se souvenir (1)	4	--	86	10	--	--	--	--	--	--	--	--
s'opposer (1)	4	--	84	8	--	--	--	--	--	--	4	--
s'opposer (2)	--	--	92	8	--	--	--	--	--	--	--	--
téléphoner (1)	30	8	58	--	--	--	--	--	4	--	--	--
téléphoner (2)	25	13	50	--	--	--	--	--	8	--	4	--
tenir (2)	4	50	13	25	--	--	--	--	--	--	--	8
tricher (1)	48	2	26	--	--	--	--	--	--	--	8	--
vendre (2)	20	64	--	--	--	4	--	--	--	4	4	--
vérifier (1)	19	81	--	--	--	--	--	--	--	--	--	--
voir (1)	4	84	--	--	8	--	--	--	--	--	4	--

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