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MODULARITY: EVIDENCE FROM COREFERENCE PROCESSING IN SPANISH

by

SHEILA MELTZER

A dissertation submitted to the Graduate Faculty in
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the degree of Doctor of Philosophy, The City University of
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CHAPTER 1

INTRODUCTION

The ongoing debate about the properties of the human language processing system has inspired a surge of experimental work designed to address issues of cognitive architecture. Much of this work has attempted specifically to address the question of whether the language processor operates in a modular or in an interactionist manner. It is recognized that these are two idealized extremes, and that the possibility also exists that reality is not quite so ideal¹. Nevertheless, it is a useful and perhaps necessary exercise for the field, in these exploratory forays, to assume an extreme hypothesis, even if that leads to the conclusion that such a hypothesis is to be rejected. Therefore I will, for introductory purposes at least, speak in terms of strictly modular versus freely interactive models.

The issue to be addressed in this dissertation, broadly put, is whether the autonomous domain defined by linguistic theory has some correlate in an empirically valid psychological model of language processing. I will present as evidence original experimental research that

¹ See, for instance, Thompson and Altmann's (1990) description of computational systems in which representational modularity and process modularity are not mutually implied.

explores the conditions under which the processor makes use of extra-linguistic information. The research asks, specifically, whether the processor makes differential use of pragmatic plausibility in its treatment of two kinds of phonologically null elements which differ in status with respect to the linguistic constraints on their interpretation.

1.1 Modular and Interactive Processing Models

A modular model of the human language processor is one in which part of the cognitive system is specifically assigned to the processing of linguistic stimuli, enjoying a cognitive autonomy that mirrors the informational autonomy of a linguistic competence model². Fodor (1983) presents a strong defense of such a modularity thesis, providing the schematic for a cognitive architecture composed of two inherently distinct types of processes. One set is composed of the global, or 'horizontal', cognitive processes such as those involved in belief fixation, analogical reasoning or inferencing - the sort of processes that are sensitive to a person's expectations, intelligence, and general world knowledge. The second set

² This notion of modularity can and has been extended (cf. Forster, 1981) to consideration of whether there are specific component modules within the larger linguistic module. These might mirror the theoretical components of the grammar, i.e. the lexicon, morphology, syntax, semantics, phonology, and possibly discourse pragmatics. These issues will not be addressed in this work; rather, the term 'syntax' will be used loosely, to refer to the grammar as a whole, bypassing unresolved questions concerning the boundaries between syntax and formal semantics.

is comprised of the input systems, or 'vertical' faculties, related to idiosyncratic processing domains including, but not a priori limited to, visuo-motor coordination, facial recognition, spatial relations, and language - faculties for which the degrees of competence are strikingly independent of the organism's powers of reasoning.

In contrast with the central cognitive processes³, each of the modular input systems is characterized by a combination of speed, mandatory application, domain specificity, shallow output and, crucially, informational encapsulation. The mechanism, once it has been automatically triggered by a stimulus relevant to its domain, is impenetrable, its operations impervious to influence from other cognitive systems. In this sense, language processing is strictly bottom-up, so that grammatical principles, where applicable, are always the first to operate. This does not imply that there is *never* any influence of extra-linguistic information on sentence comprehension, but that syntactic principles always apply before, and independently of, extralinguistic operations. Inferences based on real-world knowledge are unavailable for use in the development of the linguistic representations which are produced by the module. Like the

³ This is not to suggest that the global faculties can never demonstrate any of these characteristics, but that the complete set of them is consistently and inherently characteristic of the modular systems, and not of the central faculties.

other input systems, the language module functions to get information into the central processors; the flow of information is unidirectional. Language stimuli, once encoded by the language module, are available to the central cognitive mechanisms for further processing and integration with information from other sources.

While the attribution of speed and mandatoriness to the language processor is more or less universally accepted by researchers in this field, the same can not be said of the strict informational encapsulation which is at the core of Fodor's model. Alternative models, with a certain intuitive appeal, are characterized by a so-called interactive processor, unfettered by the rigid constraints of modularity. Such a model has been supported in work by Marslen-Wilson (1973; see also Marslen-Wilson and Welsh, 1978; Marslen-Wilson and Tyler, 1987). An interactive model of the language processor ascribes neither autonomy nor priority to syntactic processes or to any other component of the machine. Such an opportunistic parsing machine is at liberty to appeal to clues inferred from the discourse domain and beyond, without particular deference to any structural levels. Guided instead by the search for the quickest route to a comprehensive interpretation of the stimulus, such a language processor will access a wide variety of clues, syntactic as well as contextual, in order to get the job done. A sufficiently rich discourse context

could override, or even sidestep, grammatically-driven processing.

1.2 A Competence Model of the Language Module

The degree to which the real-time language processing mechanism makes reference to the linguistic competence that is studied by theoretical linguists has been under debate throughout the history of psycholinguistic experimentation. It should be said from the start that the present study is informed by the underlying assumption that the human processor does in fact have access to and make use of all the syntactic information in the competence grammar (cf. Fodor 1989, 1993). I will be assuming in this dissertation some established tenets of the Government and Binding (GB) theory of generative grammar, also known as the principles and parameters framework (Chomsky, 1986).

I turn now to the theme of coreference processing, and to how it can be used to provide evidence for the modularity debate.

1.3 Coreference Processing

Nicol (1988) makes a division between the tree-parsing and the coreference processing activities of the on-line processor, proposing that these are two distinct sub-modules. Whereas the former identifies the structural relations between constituents, the business of the latter

component, which will be the concern of this dissertation, is the interpretation of referentially-dependent elements, often called anaphora. The definition, licensing and interpretation of referentially-dependent elements, a prominent topic throughout the development of modern syntactic theory, has likewise been a focus of interest in development of a processing theory. Reflexives and reciprocals require an antecedent in the previous discourse in order to be interpretable, as do pronouns⁴. It is essential that some mechanism for their processing be included in any model of the human language processor.

The terms relevant to a discussion of referentially-dependent elements are used by language researchers working in a diversity of scholarly disciplines, often with differing intended signification. Even within the linguistic and psycholinguistic literature the terms are used in overlapping senses. The phenomenon whereby one element picks up reference through connection with an *antecedent* is usually referred to as anaphora. Any substantive which is referred back to later in the discourse is an antecedent, and the NP that refers back to it may be called an *anaphor*. The latter can be a repeated

⁴ Less obviously dependent are definite noun phrases, whose interpretation calls for reference to another entity already encountered in the discourse. In example (i) (from Heim, 1988), *the cat* in the second sentence refers back to *a cat* in the first sentence:

i. John has a cat and a dog. The cat's name is Felix.

The operation of this coreference function is outside the scope of this dissertation.

NP (e.g. *John*), another NP, (e.g. *that man*), a pronoun, (e.g. *she, he*), a reflexive (e.g. *herself, himself*) or a reciprocal (e.g. *each other*). Thus, in this common usage, the terms *anaphor* and *pronoun* overlap.

However, within a theory of sentence grammar, the terms *anaphor* and *pronoun* pick out distinct sets of NPs that fall into (a near but not totally perfect) complementary distribution with each other. This distribution is formally constrained by the binding component of the grammar. Chomsky (1981, 1982) argues that instances of the category N(oun) can be described in terms of two abstract features [+/-anaphor] and [+/-pronominal], and that these abstract features characterize commonalities between different types of NPs. The binding principles of grammar, which constrain the antecedent selection for a particular NP, do so on the basis of that NP's values for these features.

Approximately put, an anaphor (henceforth any NP that is [+anaphor]) must have a coindexed antecedent preceding it in the same (tensed) clause, while a pronominal (any NP that is [+pronominal]) may not. Anaphors are exemplified by reflexives and reciprocals, and pronominals are exemplified by pronouns. For any context in which an anaphor may appear, a pronominal appearing in that context must have disjoint reference, and vice versa, so that in (1), (b) and (d) are ungrammatical while (a) and (c) are not:

- (1)
- a. John_i likes himself_i;
 - b. *John_i likes him_i;
 - c. John_i thinks Bill_j likes him_i;
 - d. *John_i thinks Bill_j likes himself_i;
 - e. John_i thinks Bill_j likes himself_j.

There are grammatical principles which determine the choice of antecedents for an anaphor, as shown by (1)d and (1)e; in this structure, *himself* must corefer with *Bill*. In the processing of non-anaphoric nominals, however, often the only factors relevant to the identification of an antecedent are extra-grammatical ones. The relation between a lexical pronoun and its antecedent is subject to number and gender agreement, but the set of possible antecedents is not necessarily restricted to a single candidate. Consider for example (2)a and (2)b, which have identical syntactic structures:

- (2)
- a. Bill loaned Bob a dollar, but then he took it back.
 - b. Bill loaned Bob a dollar, but then he gave it back.

In (2)a it is understood that the *he* who got the dollar back was *Bill*, the same person who loaned it, while in (2)b it is understood that the *he* who gave it back was *Bob*. In these examples, the semantics of the verbs *give* and *take* imply only one sensible sequence of events. There is no

syntactic constraint that makes this distinction; non-syntactic information is needed to determine the ultimate choice of antecedent.

As examples (1) and (2) illustrate, in some cases the grammar provides positive principles that pinpoint the proper antecedent, while in other cases it provides only negative clues, making NPs within the same clause ineligible as antecedents. Thus licensing constraints on coreference appear to lie at the interface between grammar and other cognitive faculties, and the assignment of antecedents to grammatically-constrained anaphors is one example of how factors outside the grammar might plausibly influence the processor.

In an interactive model, the coreference processing of any referentially-dependent nominal can be made as soon as the mechanism has access to any relevant information. This can be achieved in a completely opportunistic manner, taking advantage of all available clues, be they syntactic or pragmatic. In a modular model, an important distinction is made. A modular processor would be encapsulated against the interactive influence of higher-level cognitive faculties, but **only** where grammatical constraints apply. Syntax requires that an anaphor and its antecedent be in the same sentence; thus the processing of the relation between an anaphor and its antecedent will be encapsulated in the language module. In the processing of nominals such

as pronouns, for which the antecedent is not selected by the grammar, non-syntactic factors will be involved, and their influence is unconstrained by modularity.

The question related to modularity can now be posed in this way: Do extra-grammatical factors influence the on-line processing of grammatically-constrained anaphors as freely as they do the processing of non-anaphoric nominals, which are grammatically-free to seek context-dependent interpretation?

1.4 On Providing Evidence for Modularity

It has been a major aim of psycholinguistics to provide empirical evidence to decide between modular and interactive models. And one of the most difficult questions is: How could modularity be supported by experimental data? While it is relatively easy to design an experiment that would demonstrate the violation of modularity, it is difficult to see how to design one that would demonstrate modularity. This imbalance stems from the fact that modular processing excludes some possibilities while interactionism does not. An instance of interaction could be identified and quantified, thus compromising a theory of modular processing. Any given instance of autonomous processing, on the other hand, would not necessarily compromise a theory that allowed for interaction.

It should be emphasized that the modularity thesis as proposed by Fodor (1983) does not claim that language comprehension as a whole will be free of effects of general cognitive processing. As noted, not all mental processes are performed within the autonomous modular systems. There is some number (yet to be empirically determined) of perceptual modules or input systems, the language processor being one of them. The perceptual stimuli, once computed by their respective modules, are available to the central cognitive faculties. Thus it is to be expected that the final outcome of language comprehension will exhibit effects of higher level cognition. But a demonstration of plausibility effects on the output of comprehension does not imply that such factors have operated throughout processing. The challenging task for experimental psycholinguistics, in testing the modularity hypothesis, is to discover which factors contribute to language processing and try to dissociate them as far as possible from each other. Once dissociated, the effects of each can be measured independently, and then it can be seen which are influencing grammatical decisions.

On the surface it might appear that a sufficient support of the modularity of language could be provided by any experimental design in which the effects of linguistic variables are demonstrated to manifest themselves faster than the eventual effects of pragmatic variables. In the

absence of alternative approaches, most research has relied solely on temporal differences to investigate these architectural issues. Experiments are often designed so as to attempt to measure a lag of pragmatically-motivated effects behind syntactically-motivated ones (e.g. Rayner, Carlson and Frazier, 1983; Swinney, 1979). But a more rapid influence of syntactic clues does not necessarily imply a modular processor; it could be that the inferencing process just takes longer to complete. What is needed is a way to demonstrate that syntax has finished its operations before pragmatics has begun its own, or at least has had a head start.

However, as argued by Fodor, Ni, Crain and Shankweiler (in press), the availability of a pragmatic clue in the materials presented to perceivers does not necessarily imply that that clue is accessible to the processor. In order to convincingly argue that a lack of interaction is due to architectural constraints, it is important to make an accompanying demonstration that the processor in fact does have access to the extrasyntactic clues at the point of measurement. If it does not have access to those clues, then the fact that it does not use them is obviously of no interest. This is the approach which has been exploited in the experiments reported in Chapter 4. In those experiments, the influence of pragmatic clues on the processing of two types of referentially-dependent nominals

was compared. For one type, the grammar leaves open several possibilities for antecedent assignment, so no restrictions on non-syntactic influences are entailed by the modularity hypothesis. Interaction effects indicating a pragmatically-induced bias were found in the coreference processing of this type of nominal; this observed effect provides evidence of the availability to the processor of the relevant discourse information. For the contrasted type, antecedent assignment is constrained by the grammar, and no such interaction effect was observed in its processing. It can be concluded therefore that this lack of interaction is due to the modular design of the language faculty.

One of the problems faced in designing an experiment that will compare processing of different kinds of linguistic elements is that it is difficult to control for all other linguistic factors. The solution adopted here was to compare two elements which are identical in all respects except in their susceptibility to structural constraints on their antecedents.

1.5 Null Pronominals

In addition to the dependent elements which are phonetically overt, there is a parallel set of covert elements which, though not perceivable by the ear and not orthographically represented, are arguably present in sentence structure. Following GB theory, these phonetically null elements, often called empty categories (ECs), pattern like overt NPs in every other way. They are subject to the full range of grammatical principles and their distribution, as for overt NPs, is determined by their values for the features [+anaphor] and [+pronominal].

GB theory distinguishes two phonetically null pronominals, PRO (also known as big PRO) and *pro* (also known as little *pro*). These two elements are licensed and interpreted by different principles of the theory; in fact, explanation of their differences has been a driving motivation in much of the theory's formal development. The definition of these elements, even the distinction between them, remains a matter of considerable debate among theorists. For the purposes of this dissertation I will assume the definitions of Chomsky (1986). These, along with the relevant facts, will be explicated in Chapter 2. Of primary interest to us are the facts which drive the differentiation between PRO and *pro*, regardless of the theoretical details of their definitions and representations. Simply put, there are two kinds of

context in which null pronominals can occur, and they fall into complementary distribution with each other.

Therefore, the theory posits two distinct null pronominal elements. PRO occurs in clauses with nonfinite verbs, and must be coindexed with an antecedent NP in a local, structurally higher clause in order to have a referent. By contrast, *pro* occurs in tensed clauses; like overt pronouns, it must not be coindexed with a local NP.

In order to compare the on-line processing of *pro* with that of PRO, it is necessary to work with a language whose grammar licenses the occurrence of both. While English contains PRO as subject of a nonfinite (i.e. uninflected) verb, it is generally accepted that English grammar does not license the occurrence of *pro* in any position. Spanish, on the other hand, while evidencing a usage of PRO similar to that of English, is a so-called 'null subject' language, permitting the use of *pro* as grammatical subject of a finite (i.e. inflected) verb. There is a grammatical English sentence (3)b that is comparable to the Spanish sentence in (3)a, but English (3)d is ungrammatical while Spanish (3)c is grammatical.

In Chapter 4 data will be presented from original experimental research conducted in Spanish with native Spanish-speaking participants. This research contributes to the recent extension of the realm of processing studies beyond the boundaries of the English language. (See the

- (3)
- a. Rita_i quiere PRO_i bailar.
 - b. Rita_i wants PRO_i to dance.
 - c. *pro*_i quiere PRO_i bailar.
 - d. **pro*_i wants PRO_i to dance.

chapters in Carreiras, Garcia-Albea and Sebastian-Galles (in press) for further studies of Spanish sentence processing.) The methodology is appropriate to the goals of the research. The experiments employ a version of the cross-modal priming paradigm (Swinney, 1979; Swinney, Onifer, Prather and Hirshkowitz, 1979) that has been used in many studies of coreference processing in English. This methodology (which will be described in detail in Chapter 3) is by now a familiar one in the psycholinguistic literature, but the present study is believed to be the first to have extended it to the examination of Spanish.

In the sentence constructions used in these experiments, PRO linearly precedes its antecedent. PRO appears in an initial subordinate clause; its antecedent is in the matrix clause which follows. *Pro* appears in matched contexts. The only difference between them is the linguistic fact that the antecedent of *pro* is not constrained by the following clause. The introduction of plausibility clues into the initial clause of these constructions enables a comparison of pragmatic influences on the processing of PRO, whose antecedent is syntactically

determined, with pragmatic influences on the processing of *pro*, whose antecedent is not syntactically determined.

In this way the grammatical distinction between PRO and *pro* can be gainfully employed in investigation of issues of modular processing. If there is evidence that PRO and *pro* are in fact treated differently, then it will be interesting to see whether that difference is as predicted by syntactic theory. In particular, it is of interest to what extent perceivers appeal to discourse context in their on-line processing of these two elements. If (a) the processor makes the same distinction between *pro* and PRO as the grammar does, and if (b) the processor is a modular one, then we would expect to see a pragmatic influence on the processing of *pro* but not on the processing of PRO in these sentences.

1.6 Organization of the Thesis

In Chapter 2 I will lay out the necessary syntactic background on *pro* and PRO, within the GB principles and parameters framework. Chapter 3 will provide the psycholinguistic background that has motivated the current research. In Chapter 4 I will report the results of two experiments which investigate whether extra-linguistic clues play a role during the processing of PRO and or *pro*. In an attempt to explain some vagaries of the central experimental results I will present details of a follow-up

experiment on the role of form-relatedness in cross-modal priming experiments. Chapter 5 will summarize the implications of the experimental work and consider some possible revisions of these experiments. Alternative interpretations of the results will be considered in light of alternative syntactic theories. I will then introduce some aspects of ongoing syntactic research which may illuminate these experimental results, particularly the increased prominence of agreement checking and its implications for the licensing and identification of implicit subjects.

CHAPTER 2

OVERT AND EMPTY PRONOMINALS: A LINGUISTIC OVERVIEW

2.1 Introduction

In this dissertation, psycholinguistic data comparing the on-line treatment of two kinds of pronominals will be considered as evidence for the modular organization of language processing. The two pronominals in question, PRO and *pro*, are both ECs which are posited as being base-generated¹ in subject position.² An EC is a syntactic element that fills a node in a phrase-structure tree. By definition an EC is void of phonetic content, but beyond that the term 'empty category' says nothing positive about what, if anything, is in fact contained in that node, or what relationship that content may have with other nodes in the tree. The ECs whose processing has been examined by psycholinguists are almost exclusively noun phrases (NPs); though they lack referential content, they serve the grammatical function of nominals, and fill NP nodes in syntactic trees.

¹ These have generally received less attention in psycholinguistics than *wh*-trace and NP-trace, ECs that are created by transformational movement of constituents.

² *Pro*, though not PRO, can also be generated in object position in Italian (Rizzi, 1986).

Because ECs cannot be heard, there is no direct, perceptual evidence for their existence³. There must therefore be some other, more indirect evidence for linguists to posit the existence of such elements. The inventory and even the existence at all of ECs is one of the most notable differences between differing theories of syntax. This reflects the fact that the motivation for their postulation has been largely theory-internal (Sag and Fodor, 1994)⁴. Section 2.2 will be a review of the GB theoretical motivation for postulating ECs, and the linguistic evidence confirming their existence. To the degree that the distribution, type and content of an empty NP can be fully determined by conditions and principles that apply to any NP, the demonstration of such a parallelism strengthens the claim that ECs exist (Bouchard, 1984). This parallelism will be illustrated in Section

³ Note that this is not a tautology. The phenomenon known as *wanna*-contraction (shown in i and ii below) has been interpreted within GB as concrete evidence for the existence of *wh*-trace. As illustrated by iii and iv, the presence of an intervening *wh*-trace appears to be incompatible with contraction of *want* and *to*:

- i. Which song do you want to hear?
- ii. Which song do you wanna hear?
- iii. Who_i do you want e_i to sing the song?
- iv. *Who do you wanna sing the song?

For discussion of this phenomenon see, for example, Chomsky (1981, 1986), Bouchard (1982), and Sag and Fodor (1995), among others.

⁴ See Sag and Fodor (1994) for discussion of the lack of theory-external evidence for the existence of ECs. A full discussion of the role of ECs in alternative theories of syntax is unfortunately outside the scope of this dissertation, but the issue will be discussed briefly in Section 5.2.

2.3, which reviews the classification of, distribution of, and licensing constraints on referentially-dependent NPs, including all those phenomena variously known as pronouns, anaphors, and syntactic movement traces, the entire set of which, whether phonetically empty or overt, can be subclassified by two abstract features. This will be followed by a discussion of the identification (i.e. interpretation) principles for the two null pronominals, *pro* (in Section 2.5.1) and *PRO* (in Section 2.5.2).

2.2 The Projection Principle and Null Pronominals

Every verb discharges a certain number of prespecified thematic roles, inherent in the semantics of that verb, onto its neighboring phrases (its arguments). For instance, if a given verb has a *PATIENT* in its θ (thematic) grid, then a clause headed by that verb cannot be understood without a nominal (at least, implicitly understood as present) representing that role. In the Spanish and English examples alike in (1), the verb *perseguir* (to chase) requires that some NP be understood as denoting what is being chased:

- (1)
- a. What did the cat chase?
 Qué perseguía el gato?
 - b. The cat chased the mouse.
 El gato perseguía el ratón.
 - c. *The cat chased.
 *El gato perseguía.

At D-Structure, these thematically relevant relationships, which are encoded in the θ -grid of the predicate, are represented as grammatical functions (e.g. subject, direct object, indirect object). In this way the θ -grid determines the minimal composition of the syntactic clause.

Some argument phrases are moved during the derivation of S-structure from D-structure, to satisfy other principles of the grammar, such as the Case Filter⁵, given in (2). These representations are always guided by the θ -criterion (2), which says essentially that no argument can be in a chain that has less than or more than one θ -role. A chain is a set of (one or more) coindexed constituents, each of which locally binds the next member. A multi-membered chain is created by movement of an NP from its D-Structure argument position and consists of all positions through which it has moved.

⁵ Chomsky (1986) proposes to eliminate the Case filter as an independent principle, replacing it with the visibility condition: an element is visible for θ -marking only if it is assigned Case (or linked in a chain to such a position).

(2) Case Filter:

*NP if NP has phonetic content and has no Case
(Chomsky, 1981: 49)

(3) Projection Principle:

Representations at each syntactic level (i.e., LF, and D- and S-structure) are projected from the lexicon, in that they observe the subcategorization properties of lexical items.

The Logical Form (LF) representation of a clause is a formal representation of the structural meaning⁶ of the sentence, including these argument relationships inherent to the verb. The generalization that representations at each syntactic level are projected from the lexicon is captured by the Projection Principle (0), (3) (Chomsky, 1981), which expresses the theoretical axiom that the thematic properties of a tree remain constant throughout the syntactic derivation. In other words, each understood argument of a verb must be represented at each syntactic level, either in phonetically realized form or as an empty category.

It is possible for there to be an argument phrase where there is no θ -role, as long as it is licensed in some other way. For example, not all verbs assign a θ -role to the subject position. In that case, some languages, English among them, require there to be a lexical expletive

⁶ The reader is referred to Chapter 11 of van Riemsdijk and Williams (1986) for an explication of the concept of 'structural meaning' as a subtheory of meaning.

pronoun (*it* or *there*) in subject position. As shown in (4), while neither a referring expression nor a full pronoun can appear as subject of such predicates, an expletive pronoun can and must fill the subject position:

- (4)
- a. *The discovery/*Rita/*she amazes Calvin that linguistics is not more popular.
 - b. It amazes Calvin that linguistics is not more popular.
 - c. *Amazes Calvin that linguistics is not more popular.

This fact led Chomsky to propose the Extended Projection Principle (5) (Chomsky, 1982), the stipulation that a subject is an obligatory constituent of every clause, and accordingly there must be one present at every level of grammatical representation. Where there appears to be none, the subject must be an empty category.

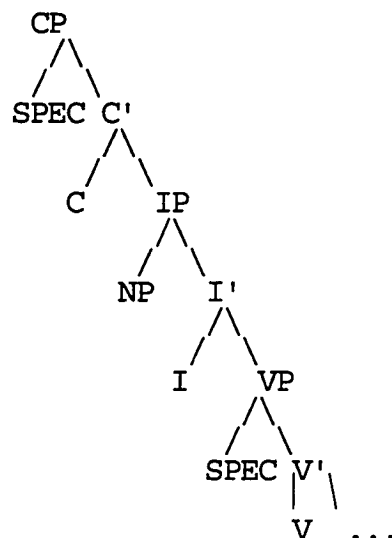
(5)

"I will henceforth refer to the Projection Principle along with the requirement that clauses have subjects as the *Extended Projection Principle*." (Chomsky, 1982:10)

To illustrate the relevant configurational relationships, let us assume a tree representing the

structure of the clause, a projection of C(omplementation) which selects IP, as shown in (6):⁷

(6)



The inflectional projection IP is, essentially, what was previously called S, and INFL(ection) is taken to be the head of the clause. AGR, the agreement feature in INFL, is governor of and coindexed with the subject NP, which is here presumed to be generated in the Spec(ifier) node of IP (though later analyses assume it originates in VP and is

⁷ In keeping with Chomsky (1986) I am assuming here one inflectional projection, INFL, head of the sentence, which is composed of the elements AGR and Tense. More recent research has led to the now standardly accepted split INFL proposal (Pollock, 1989; Belletti, 1988) whereby the old INFL is in fact (at least) two complete inflectional projections, AGRP and TP. Some of the implications of this theoretical development for psycholinguistic research will be addressed in Section 5.5.

moved up into IP (Sportiche, 19xx)). The notion *SUBJECT* is introduced (Chomsky, 1981:209) to encompass the 'most prominent nominal element'. In a tensed clause, AGR is coindexed with the NP it governs; it is a pronominal element and, because it is the head of the clause, it is 'the most prominent nominal element.' Hence it, not the subject NP, is the *SUBJECT*. (The relevance of *SUBJECT* will become clear during the discussion of binding theory in Section 2.3.) *INFL*, a composite node, encompasses values for both agreement and tense features; nonfinite clauses typically are distinguished from finite clauses by negative feature values for Tense⁸ and AGR. In a nonfinite clause (or a small clause), since there is no AGR, the most prominent nominal is the subject NP.

Cross-linguistically nonfinite clauses most often lack overt subjects⁹. The English and Spanish examples in (7)

⁸ Stowell, 1982 suggested that gerunds, in contrast with tensed and infinitive clauses, do not have a tense operator. The lack of tense is evidenced by the fact that the understood tense of the gerund is dependent on the semantics of the governing verb.

⁹ English is somewhat exceptional in this respect; it allows overt subjects of nonfinite verbs fairly freely. For example:

- i. I can't wait for [John to leave].

These subjects must be licensed. For instance, since they are overt they need Case (see (2) above). In (i), *John* is governed from *COMP* by the preposition *for*, which is an accusative Case assigner in English. As (ii) shows, a lexical NP is required in this position while, as shown by (iii), it is illegitimate without the *for*.

- ii. *I can't wait for [PRO to leave].

- iii. *I can't wait [John to leave].

In (iv), there is a possessive element in the *Spec* position of the NP *Bill's*, assigning Case to the subject *Bill* and serving as a realization of Genitive case (Chomsky,

(continued...)

are typical. The subject in the infinitival clause (7)a-b and the gerundive clause (7)e-f is understood; the ungrammaticality of (7)c-d and (7)g-h shows that the subject may not be overt here, in either language:

- (7)
- a. Mary doesn't know what to do.
 - b. Maria no sabe que hacer.

 - c. *Mary doesn't know what Mary to do.
 - d. *Maria no sabe que Maria hacer.

 - e. Carl won his fortune playing the lottery.
 - f. Carlos ganó su fortuna jugando la lotería.

 - g. *Carl won his fortune Carl playing the lottery.
 - h. *Carlos ganó su fortuna Carlos jugando la lotería

In (7)a-b,e-f the subject of the embedded clause is coreferential with the subject of the matrix clause (*Mary* (*Maria*) in (7)a-b and *Carl* (*Carlos*) in (7)e-f, but it has its own θ -role, which it gets from the embedded nonfinite verb (*to do* (*hacer*) in (7)a-b and *playing* (*jugando*) in (7)e-f). Thus it is required by the Theta Criterion (2) to be distinct from the matrix subject. The Extended Projection Principle expresses the syntactic condition that every verb have a subject; where not overt it will be null.

⁹(...continued)
1986):

- iv. John denounced Bill's eating all the cake.

There are also some examples of overt subjects of non-finite verbs in Romance languages, including Spanish, although they are considerably less common than in English (see Sections 4.3.1.5 and 5.3.3).

Chomsky (1981) introduced the base generated empty category PRO as the default subject of infinitival and gerundive verbs. Thus the subject of the embedded verb in (7)a-b and (7)e-f is PRO.

Unlike English, the grammar of Spanish, like all the major Romance languages with the exception of French, allows as well for an EC in the subject position of a finite verb, as illustrated by (8):

- (8)
 Compró dos libras de patatas.
 bought (3sg) two pounds of potatoes
 'S/he bought two pounds of potatoes.'

This EC, which is referred to as *pro*, or little *pro*, is licensed here by AGR (Rizzi 1982 and 1986; Jaeggli and Safir 1989). More generally, *pro* is licensed by the heads of some (not all) syntactic categories. Whether or not a category licenses *pro* is a parameter of UG, and the correct settings must be learned by the child while acquiring a language. Languages in which *pro* is licensed in subject position of finite verbs are known as null subject languages (NSL), sometimes called *pro*-drop languages.

As expressed by Bouchard's Principle of Denotability (9), a crucial part of the content of an EC is its

referential index (henceforth R-index)¹⁰, which it shares with another nominal element:

- (9) An NP will denote an object in domain D only if that NP has an R-index.

Following Chomsky (1981), domain D contains 'mental objects' to which languages can refer. While these mental objects can be representations of real world objects, that is not necessarily the case; languages can refer to *unicorns* and *world peace* regardless of their existence in the real world. The Principle of Denotability governs the pairing of NPs with objects in domain D.

Chomsky's (1986) Principle of Full Interpretation entails that every expression contributes to the interpretation of the sentence at LF; hence every EC must have a means by which it inherits content, in order for it to be interpretable at LF. Lacking lexical content, a null argument must be coindexed with some other nominal element (its antecedent) in order to inherit identifying Phi (agreement) features. The minimum requirement for any argument NP, overt or null, is to be specified for number; if it is to be referential, it must be specified as well

¹⁰ An R-index (usually called *index*) is a subscript number or letter that is appended to an element in a syntactic representation. Strictly with reference to syntactic structure, but not necessarily with reference to real world entities, elements with the same index are identical.

for person (Rizzi, 1986:543)¹¹. A null argument will inherit these necessary features from its antecedent. Any additional agreement features present on the antecedent, such as gender, will also be shared.

Underlying the postulation and categorization of ECs is the assumption that they are in many respects parallel to overt NPs. Therefore the current discussion of the licensing and identification of null subjects will be prefaced with a review of binding theory, that component of the grammar that explains the distribution of all NP-types (without reference to their phonological status) in terms of their dependence on (or independence from, as the case may be) other nominal elements. Such dependency relations, which result in a shared R-index and agreement of Phi-features, will be defined with reference to a structurally local domain (which never extends beyond the sentence) in the syntactic constituent tree, to be defined below in Section 2.3.

2.3 Referentially-Dependent NPs: Principles of Distribution

The binding theory is the subcomponent of the grammar that determines which elements must be bound and in which

¹¹ This is not true of languages, such as Chinese and Japanese, in which phi-features do not appear to play any role at all. Rizzi proposes another parameter which selects either for or against the use of agreement. In the latter case, agreement features are not necessary on any NP, empty or overt.

structures they are bound. Following the standard GB approach (Chomsky, 1981, 1986) binding is defined as in (10) and c-command as in (11):

(10) An NP is *bound* by a c-commanding coindexed element, if there is one in the sentence; otherwise, it is *free*.

(11) α c-commands β iff α does not dominate β and every γ that dominates α dominates β .

The standard binding theory has evolved through several different formal definitions of anaphors and pronouns during its development by Chomsky in various works over two decades (Chomsky 1973, 1980, 1981, 1982, 1986). Further modifications, motivated by the need for parameterization as evidenced from cross-linguistic studies (see the papers in Koster and Reuland, 1991, among others) have since been proposed. Despite these variations, the respective sets of elements selected by the terms have remained consistent; the changes have been in the formal definitions, not in the groups they pick out.¹²

¹² Lebeaux (1983) observed that reflexives require proper government, whereas reciprocals do not, leading to a more restricted distribution for the former than for the latter. He proposed that while they are both subject to Principle A, only reflexives are also subject to the Empty Category Principle (ECP) at LF, thereby requiring proper government. I will not discuss the movement of anaphors at LF.

The standard formulation of binding theory (Chomsky, 1981) distinguishes three classes of NP, each constrained by one of the three binding¹³ Principles A, B and C:

(12)

A An anaphor is A-bound in its governing category.

B A pronominal is A-free in its governing category.

C An R-expression is A-free.
The governing category¹⁴ in which an anaphor must be

bound and a pronoun free, is a 'complete functional complex' (Chomsky 1986). This is a local domain in which

¹³ Each of these binding principles involves only A-binding, i.e. binding by an NP in a potential argument position. This excludes, specifically, binding by a moved *wh*-word in Comp position, as well as binding from A'-positions of, for example, topicalized NPs. Though it will not affect the discussion here, it is noted that the precise definition of A-position has become more complicated following the VP-internal subject hypothesis (Sportiche, 1988), and due to the complexity of scrambling in languages like Japanese and German.

¹⁴ The expanding body of research into languages other than English has motivated several proposed revisions of the binding principles. Complications arise, for example, in a number of languages including Icelandic (cf. Sigur sson (1986) and Thráinsson (1991) and references therein) and Finnish (cf. van Steenbergen (1991)), which have long-distance reflexives whose governing domain cannot be defined structurally so as to exclude pronominals from the same domain. That is, Principle A does not rule out the binding of a reflexive across an infinitival clause boundary. Reinhart and Reuland (1991) argue that these data can be accommodated by defining two different domains for binding, a local domain characterized by the minimal accessible subject, and an extended domain, characterized by the minimal finite inflection. Any remaining counterexamples fall outside binding domains entirely and can be explained by logophoricity. (Logophoricity, a functional account of an individual as the center of the discourse, will be discussed further in Section 2.5.2.1.)

Since these issues are not directly relevant to a discussion of English or Spanish anaphora, these proposals will not be pursued further here.

all the grammatical functions associated with a head are realized. It is the minimal projection containing a lexical governor (the head), the complements (which receive the internal θ roles assigned by that head), and the subject (which is assigned the external θ -role). It follows that the relevant domain can only be a sentence or an NP with a subject¹⁵.

Following Principle A, an anaphor must be bound in its governing category: the complete functional complex of its governor. A reflexive, which is an anaphor, is barred by Principle A from nominative subject position in a finite clause as in (13)a. This is because the subject NP and its governor AGR are both contained within the minimal S, but there is no c-commanding NP possible within that construction¹⁶. A reflexive is grammatical in the subject

¹⁵ In order to count in determining the binding domain for an anaphor the subject must be *accessible* in the sense that coindexation of an anaphor with it would not violate any other grammatical principles, specifically the *i*-within-*i* filter (Chomsky, 1981:212), which blocks circularity:

- i. * $[\dots\delta\dots]$, where γ and δ bear the same index

In (ii) below, and in contrast with (iii), the anaphor *each other* has an accessible subject (the genitive NP *my*) inside the object NP. Hence (ii) is ungrammatical due to a Principle A violation, but (iii) is not:

- ii. * they heard [NP my stories about each other]
 iii. they heard [NP the stories about each other]

¹⁶ But see Chomsky (1986:176), for a proposal that this is rather a violation of the Empty Category Principle, a licensing and identification condition on movement
 (continued...)

position of a nonfinite clause, as in (b), if it is governed by an exceptional Case marking verb in a higher clause, because then the governing category includes the higher clause. For instance in (13)b the reflexive is governed by *believe*, making the matrix clause the governing category, which includes the c-commanding NP *John*.

- (13)
- a. * John_i believes [himself_i is clever]
 - b. John_i believes [himself_i to be clever]

Principle B captures the complementary distribution of anaphors and pronouns, by imposing the converse constraint on pronominals. A pronominal must be free in its governing category. The pronoun in (14)a can be coindexed with *John* because its governing category is the embedded clause, while in (14)b it is illicitly coindexed within its governing category, the simple clause. In (14)c, in the complement of the exceptional Case marking verb *believe*, the coindexed pronoun is illicitly bound by the coreferential subject of the governing matrix clause.

- (14)
- a. John_i believes [he_i is clever]
 - b. *John_i likes him_i
 - c. * John_i believes [him_i to be clever]

¹⁶(...continued)

traces, if anaphors in the position of subject of finite clause are considered to be variables, and binding theory to apply at LF. The reader is referred to Chapter 9 of Haegeman (1994) for clarification.

Principle C¹⁷ expresses the fact that a R(eferential)-expression (a full lexical NP) can never be bound¹⁸. This is illustrated by the unacceptability of (15) with the given indexing.¹⁹

- (15)
- a. * John_i believes John_i to be clever
 - b. * John_i believes John_i is clever

Just as there are two kinds of overt NPs which are [-pronominal] ([+anaphor] reflexives and [-anaphor] R-expressions), there are two kinds of [-pronominal] ECs posited within GB. The distribution of *wh*-trace, which is [-anaphor], parallels that of [-pronominal, -anaphor] overt elements, R-expressions. The wealth of literature on these two ECs will not be reviewed here²⁰, since our specific interest in this dissertation is in the pronominal

¹⁷ It has been argued that Principle C may be unnecessary, applying by default (Chomsky 1982), or from independently motivated pragmatic constraints. See Lasnik (1989) for a discussion of the relevant arguments and a proposal for revision of Condition C. Regardless of these details, Principle C, since it concerns the distribution of lexical NPs and bound variables (such as quantified elements), is not relevant to our discussion of referentially-dependent NPs.

¹⁸ Anaphoric epithets (e.g. *the idiot* in the following example) can take antecedents, but they cannot be bound (i.e. c-commanded) by the antecedent (Lasnik, 1989:153):

- i. After John_i walked in, the idiot_i sat down.

¹⁹ There are unusual contexts of 'accidental coreference' in which such sentences can be used; see Fiengo and May (1994) for discussion. But in normal circumstances they are unacceptable.

²⁰ I will return in Section 5.2 to a summary discussion of traces and the role they have played in arguments concerned with the transparency of processing.

elements. The discussion will turn now to the licensing of *pro* and PRO, the two null pronominals.

2.4 A Typology of Empty Pronominals

Whereas the [-pronominal] ECs *wh*-trace and NP-trace are generated as a result of syntactic movement, an EC can also be base generated at D-structure; this is the case for both *pro* and PRO. Unlike a movement trace, a [+pronominal] EC has its own θ -role, which it is assigned by its lexical head.

Pro is a pure pronoun. Hence, as shown in the Spanish example in (16) (from Jaeggli and Safir (1989), it can appear unbound²¹ as a subject in a simple clause in languages which license it:

- (16)
pro vió ese film.
 'she/he saw that film.'

Pro will be discussed in detail in Section 2.5.1.

Two features with binary values give four distinct feature arrays; thus far²² in the discussion, three of those matrices have been attributed to a non-overt NP type. Are there elements that are [+anaphor, +pronominal]? If there were, it would appear to create a paradox insofar as

²¹ Recall that 'unbound' here means A-free; as shall be seen in Section 2.5.1 below, *pro* is in fact bound and governed by AGR.

²² In the chronological development of GB theory, PRO was introduced (Chomsky, 1981) before *pro* (Chomsky, 1982 and Rizzi, 1981).

the binding principles are concerned, for such an element would be subject to both Principle A and Principle B, which cannot be simultaneously satisfied. Such a paradox would be avoided, however, if the nominal did not have any governing category, for then it would be subject to neither principle. An element with no governing category could not be assigned Case, because Case is assigned under government. It follows that there can be no lexical (i.e. overt) NP meeting these specifications, as it would violate the Case filter. In fact this is precisely the condition in which the null subject of nonfinite clauses is found. It appears in complementary distribution with lexical NPs, in Caseless subject positions only. Chomsky (1981) introduced the empty category PRO as subject of nonfinite clauses. PRO is anaphor-like in that it exhibits the same distribution pattern as lexical anaphors with respect to binding across clause boundaries. Binding options across an IP are illustrated in (17): (All examples in this section below are adapted from Freidin, 1992:314.)

(17)

- a. We_i expect [PRO_i to see Mary at the meeting].
- b. We_i expect [each other_i to see Mary at the meeting].
- c. *We_i expect [Mary to see PRO_i at the meeting].
- d. *We_i expect [Mary to see each other_i at the meeting].

Like reflexives, PRO may occur as the subject (17)a, but not as the object (17)c, of an infinitival complement. The similarity of distribution extends to binding into finite

complement clauses, as seen in (18) (from Freidin). In this case PRO, just like the reciprocal, can appear neither in subject nor object position:

- (18)
- a. *We_i expect [_{CP} (that) [PRO_i will see Mary at the meeting]].
 - b. *We_i expect [_{CP} (that) [each other_i will see Mary at the meeting]].
 - c. *We_i expect [_{CP} (that) [Mary will see PRO_i at the meeting]].
 - d. *We_i expect [_{CP} (that) [Mary will see PRO_i at the meeting]].

In other ways, however, PRO is pronoun-like. Unlike lexical anaphors, PRO cannot be bound in a simple sentence like (18)a or in an NP as in (18)c; as shown in (e), it need not be bound at all:

- (19)
- a. *John_i admires PRO_i.
 - b. John_i admires himself_i.
 - c. *We_i read [_{NP} several books about PRO_i].
 - d. We_i read [_{NP} several books about each other_i].
 - e. It is difficult [_{CP} C [_{IP} PRO to form an opinion with so few facts]].

We can now answer affirmatively the question posed on page 36: are there elements that are [+anaphor, +pronominal]? Given its combination of anaphor-like and pronominal-like behaviors, PRO is precisely such an element. The distribution of PRO is derived via the binding theory and stated in the PRO Theorem: PRO must be ungoverned.

Accordingly, the only grammatical structure containing PRO is one in which it is base-generated in a position where a lexical NP is disallowed²³ because Case is not assigned to this position²⁴. As was seen in Section 2.2, this is true for the subject position of an infinitival or gerundive verb²⁵, whose INFL, being [-Tense] and [-AGR], is not a Case assigner. The identification of PRO will be discussed in some detail in Section 2.5.2.

2.5 Identification of Null Subjects

Chomsky (1981, 1982) postulated the existence of only one EC, of which *pro*, PRO, *wh*-trace and NP-trace are just variants. The distribution of the four variants, just like that of lexical NPs, is derived via the binding theory. Our concern here is with the two base-generated variants. When the base-generated EC is governed, it is what has been labeled here as *pro*, as discussed above. When it is ungoverned, then it can be called PRO. The following

²³ Earlier analyses had a base-generated NP that was then deleted by a transformational rule (Equi NP Deletion). Such a rule overlooked the generalization that languages have rules supposedly deleting subjects, but not objects. Under the LGB analysis, the latter is illegitimate because an object does have a governor - the finite verb - and hence a governing category, thereby disallowing the appearance of PRO.

²⁴ A technical complication has recently arisen with respect to constructions in which the position where PRO and Case interact is not the one where it is generated. I will return to some of the theoretical developments connected with this in Section 5.5.

²⁵ Except in the complement of an Exceptional Case Marking verb.

ungoverned, then it can be called PRO. The following sections (2.5.1 and 2.5.2) review the standard literature on the licensing and interpretation of these two kinds of null subjects.

2.5.1 Null Subjects of Tensed Clauses

There are two major questions concerning *pro*: how and where it is licensed, and how it is identified in licensed positions. The answer to the first is presumed to depend on a language-specific parameter, and there has been a great deal of interest in the cross-linguistic clustering of properties associated with the 'pro-drop' parameter. We will look briefly at the licensing of *pro* before turning to the identification procedures for licensed *pro*, which are our major concern.

It is generally considered to be significant that the licensing of null subjects usually correlates with other independent properties, most notably optional post-verbal placement of subjects²⁶ and the acceptability of subject extraction over a lexically filled complementizer. These occur in Spanish, as shown in (20), but neither is grammatical in English, as shown in (21):

²⁶ Brazilian Portuguese has been noted as an exception (Chao, 1980), disallowing subject inversion in tensed embedded sentences while allowing null subjects, although with a much narrower use than in Spanish and Italian. I will return to this in Section 5.3.3.

- (20)
- a. Ha llamado Julio.
 pro_i has called Julio_i
 'Julio has called'
 - b. Quien crees que ha llamado?
 who_i do you think [that e_i has called]?
 'Who do you think has called?'
- (21)
- a. *Has called Julio.
 - b. *Who do you think that has called?

If a group of properties which consistently clustered cross-linguistically could be identified, there would be stronger grounds available for testing the validity of any given hypothesis about the null subject parameter. A hypothesis which could account for the existence of all the relevant correlates would be preferred to one which could account only for some. Several hypotheses have been proposed about the licensing of *pro* and the related cluster of phenomena. All of them relate in one way or another to the special status of the inflectional system and agreement morphology of the language.

Another correlated property concerns the contrasting behavior of the auxiliary systems (Zagona, 1982; Hyams, 1989). It has been claimed that in non-NSLs, modals are lexically specified under the constituent AUX, distinctive from main verbs. There may be some problems with this proposal (e.g. French and German, which are non-NSLS but have verbal-like modals), but they may be set aside here.

Modals in English, unlike main verbs, have absolutely no verbal morphology, whereas in Italian and Spanish the corresponding verbs exhibit the complete inflectional paradigm. Further, NSLs lack overt expletive pronouns (Hyams, 1986 and 1989)²⁷.

Kayne (1989) demonstrates that only NSLs allow clitic raising, and argues that both phenomena are licensed by a strong INFL. His examples from French and Italian are seen in (22)a (b), respectively:

- (22)
- a. *Jean les veut voir.
 - b. Gianni li vuole vedere.
John them wants to see
'John wants to see them.'

In Italian INFL is strong enough to L-mark²⁸ infinitival VP, so that the VP is not a blocking category (barrier) to government. Therefore, a clitic can climb and attach to INFL, while still antecedent-governing its trace. In French (which has a weak INFL (and therefore does not

²⁷ Hyams (1989) suggests that this might be due to the general restriction of the use of overt pronouns in NSLs to purposes of contrast, emphasis, or to introduce a change of discourse topic.

²⁸ L-marking refers to the special relation between a lexical item and the complement which it governs and θ -marks. The definitions for L-marking and blocking category are given below (from Chomsky, 1986b:14-15):

L-marking

A L-marks B if and only if A is a lexical category that theta-governs B.

Blocking Category (BC)

C is a BC for B if and only if C is not L-marked and C dominates B.

admit null subjects), the VP would be a barrier, so the raising of clitics would cause a violation of the proper government of traces; clitics must therefore remain attached to V.

Borer (1989) proposes that there is only one type of null subject which she calls *pro*, and that the standard distinction between PRO and *pro* is merely a reflection of variation in the values for a set of four features attributed to the AGR node. One of these features is [+/-IDENT], i.e. the presence of inflectional richness. This is the licensing factor for subject *pro* in the 'strong' tensed clauses of classical null subject languages like Spanish, where *pro* can be identified by AGR, which is [+IDENT]. This is in contrast with English, where AGR is [-IDENT].²⁹

Following Rizzi (1986), the licensing of *pro* is determined by a multivalued parameter. The licensing principle for *pro* is as in (23):

- (23) *pro* is governed by X^0_y

The possibility of subject inversion follows from the licensing of *pro*; when the subject is postverbal, an

²⁹ Another of the features attributed to AGR by Borer is [+/-ANAPH]; when anaphoric it is lacking an inherent set of i-features, and must be bound. This is the case in infinitival and gerundive clauses, where AGR looks to the next higher c-commanding AGR for identification, resulting in the facts that most linguists attribute to a separate control module.

expletive ([+dummy]) *pro*³⁰ appears in subject position (Rizzi, 1982; Chomsky, 1986). The adjoined inverted subject forms a chain with the dummy *pro* and receives its Case and θ -role by a transmission convention (Rizzi, 1982).

As expressed by (23), the class of licensing heads *y* (where a 'licenser' is a governor) varies from language to language. English has no heads of the type *y*, hence does not license the occurrence of *pro* anywhere. In Spanish, INFL is a governor of *pro*, so *pro* appears in subject position. In Italian both INFL and V are licensors of *pro*, so *pro* appears in both subject and object position. French counts V and possibly P, but not Infl, in the set of *y* type heads. In principle, languages may range from a maximally restrictive parameter setting (i.e. no head can license *pro*) to a maximally liberal setting (i.e. every governing head³¹ can license *pro*). Rizzi (1986:520) defines the following convention for interpreting the features of *pro*:

(24)

Let X be the licensing head of an occurrence of *pro*; then *pro* has the grammatical specification of the features on X coindexed with it.

In languages where INFL is a licensing head for *pro*, INFL is a verbal affix with pronominal properties, i.e. it is

³⁰ This is an instance of movement to a c-commanded position; hence it is clear that the empty category in the preverbal position can not be an anaphoric trace, which would be in violation of Principle A.

³¹ The set of possible governors includes INFL and every lexical (N,V,P,A) head.

[+pronominal]. AGR optionally bears the Phi-features essential to identification of a full pronoun. In this case, these features are coindexed (by superscript) with *pro*, which recovers them via this head binding. When there are insufficient phi-features on AGR, then arb is assigned to the direct θ -role by rule (25) (Rizzi's 43):

- (25)
Assign arb to the direct θ -role.

Rule (25) is parameterized to apply either lexically, an example being English, or syntactically, as in e.g. Italian. In the former case, the rule having applied in the lexicon, the θ -role is discharged before the Projection Principle applies in the syntax, so that position is never syntactically projected. In Italian Rule (25) applies in the syntax, assigning the arb features of [+human, +generic, +plural].³²

According to Jaeggli and Safir (1989), *pro* is licensed in all and only languages with morphologically uniform inflectional paradigms, as expressed by (26), where uniformity is as in (27):

³² This can be seen from the agreement marking on Italian adjectives, as shown, for example, in (i), from Chomsky:

- i. non è chiaro come essere allegri
'it is unclear how to be happy(plural/male)'

(26) The Null Subject Parameter
 Null subjects are permitted in all and only languages with morphologically uniform inflectional paradigms.

(27) Morphological Uniformity
 An inflectional paradigm P in a language L is morphologically uniform iff P has either only underived inflectional forms or only derived inflectional forms.

English has a uniform past tense affix (-ed) for regular verbs, but many of its present tense verbs are underived. Because this is a mixed rather than a uniform paradigm, English is not an NSL. All tensed verbs in Spanish are morphologically distinct from the stem, making it a uniform paradigm; this is why it is an NSL. And in Chinese there are no complex verb forms, so Chinese is also an NSL.

Jaeggli and Safir's identification procedure, like that of Rizzi, is strictly configurational. As expressed by (28), *pro* can be identified by AGR when AGR is governor of the subject position:

(28) Identification by Agreement
 AGR can identify an empty category as thematic *pro* iff the category containing the AGR Case-governs the empty category.

Jaeggli and Safir propose that, in a language that licenses null subjects based on its uniformly derived verbal morphology, the null subject must be identified in order to be recognized as an argument, to receive its designated θ -

role, and so to satisfy the Theta Criterion. Their theory differs from that of Rizzi in that, in order to be a licenser of *pro*, a category must be sufficiently rich, i.e. contain the relevant agreement affixes. There is an object agreement paradigm in Italian that shows up on adjectives, as shown in (29), from Rizzi:

- (29)
- a. Un dottore serio visita _____ nudi.
'A serious doctor visits _____ nude[+pl].'
A serious doctor visits nudes.
 - b. Di solito, Gianni fotografa _____ seduti.
'In general, Gianni photographs _____ seated [+pl].'
In general, Gianni photographs seated people.

In (29)a, the adjective *nudi* cannot be predicated of *un dottore*, because it bears a plural agreement marker. Likewise in (b), *Gianni* cannot be the one who is seated because *seduti* is plural. These sentences are grammatical because the adjective can modify the understood (plural) object. In the English translations, however, the adjective can not be predicated of the object, and must be understood to apply to the subject. This was one of Rizzi's reasons for claiming that there is an empty object NP in Italian, but no object NP at all in English.³³ I will be assuming henceforth the licensing condition and

³³ This remains unexplained under Jaeggli and Safir's analysis where, because the agreement does not appear on the verb itself, it should not be sufficiently rich to facilitate identification of a null object.

recovery procedures of (Rizzi 1982, 1986), which allow for the use of default feature values in assigning arbitrary reference to *pro*.

2.5.2 Null Subjects of Nonfinite Clauses

A verb that is nonfinite, i.e. either gerundive or infinitival, has as its subject the EC called PRO. PRO is defined as being simultaneously an anaphor and a pronominal; given the paradox implied by the application of both Principles A and B, it follows that PRO can only appear in a position in which no local domain can be defined, i.e. an ungoverned position (the PRO theorem) (cf. Section 2.3). Lacking semantic content, the EC must be identified. The principles of the Binding Theory account for its distribution but, since it does not have a local domain (or, vacuously, a governor within that domain), they cannot determine its reference.

There are some contexts, which will be discussed shortly, in which PRO is not required to be coindexed with a higher argument, and in which it is understood as having arbitrary reference. Other than in those contexts, there is a coindexed antecedent of PRO, the phi-features of PRO must agree with those of the antecedent, and the reference of PRO is attained via that shared R-index. This coreference is determined by a relationship called control, which is accounted for by another subcomponent of the

theory. PRO is controlled by (i.e. coindexed with) an antecedent in the next higher clause, even though there is no syntactic chain linking them and no government relationship between them. In (30), for example, it is clear that the person (PRO) who will buy a telephoto lens is the person called Gil:

Gil_i decided PRO_i to buy a telephoto lens.

Like overt pronouns and *pro*, PRO has a theta role of its own, independent of that of its antecedent. PRO is also like a pronoun in that it can be either free or bound. It is like an anaphor, however, in that it has no independent reference. If there is an NP 'appropriately related' (i.e. subject or object) to the head of the minimal dominating clause, then PRO is coindexed with that NP, its controller, thereby behaving anaphorically (i.e., being locally bound):

(31)

- a. Henry advised Maureen PRO to look after herself/*oneself.
- b. Henry promised PRO to look after himself/*oneself.

If PRO remains unbound in the local domain, then it is like a pronoun in that can be either free or bound. If there is no available antecedent, then PRO is by necessity free and gets an arbitrary, generic interpretation, as in (32).

- (32)
- PRO_{arb} Voting twice is illegal
 PRO_{arb} To vote twice is illegal

If there is a more remote antecedent available, then PRO is bound by it³⁴:

- (33)
- a. John_i announced the decision [PRO_i to feed himself_i]
 b. *John_i announced the decision [PRO_j to feed oneself_j]

Even when PRO is bound by a remote antecedent, it is still anaphorlike in that a bound PRO must be in the c-command domain of its antecedent. For instance, in (34) *John*, which is embedded in the NP *John's friends*, does not c-command PRO. Hence (34)a is ungrammatical because there is no singular local binder for himself, while (34)b is grammatical because *himself* is locally bound by *him*:

- (34)
- a. *John's friends think it is illegal [PRO to feed himself]
 b. John's friends think it is illegal [for him to feed himself]

PRO is pronounlike, however, in that when it is not locally bound it is free to corefer with any other NP in the sentence. In (35) PRO can freely be interpreted as

³⁴ It has been suggested that the antecedent of PRO is not *John* here but rather an understood PRO subject of *decision* (cf. Chomsky, 1982:fn24).

taking either the non-c-commanding *they* within its clause or the remote subject *we* as its antecedent:

- (35) We feel that [PRO learning to cooperate] is important for their development.

Noting an overlap between binding theory and control theory, Manzini (1983) (among other investigators, including Bouchard (1984) and Koster (1984)) have attempted to integrate the two components, pursuing the notion that control is fundamentally a form of anaphora³⁵. Under the theory of control proposed by Manzini, PRO is a pure anaphor that is restricted by Case requirements to the position of subject of nonfinite clauses. While it lacks a governing category, the clause in which it occurs is itself governed by the verb of the higher clause in which it is embedded. In this way PRO, by an extended Principle A, is bound in its 'domain-governing category,' which is defined in (36):

When PRO appears inside a subject NP (as in (37)a, examples from Manzini) it remains unbound, because a

³⁵ In a radically alternative proposal, Williams (1980) invokes operations at an additional grammatical level which he calls Predicate Structure. The rule of predication coindexes a predicate with a c-commanding antecedent NP. Every predicate must have a unique antecedent, by virtue of which it acquires propositional content. Predication is thematic if the predicate is a complement of the matrix verb; otherwise it is grammatical. Either way, under predication, control is obligatory. If the clause in question has no c-commanding NP it is in a nonpredicate position and it is marked 'arb' at P-structure. In these cases, PRO is interpreted at LF as generic or, if some NP commands X_{arb} , they may be coindexed, optionally.

(36) Domain-Governing Category

γ is a domain-governing category for α iff

- a. γ is a governing category for the c-domain of α , and
- b. γ contains a subject accessible to α .

prerequisite for a domain-governing category, an accessible SUBJECT, is not met. Therefore, because it is an anaphor without specific independent reference, PRO is assigned an arbitrary interpretation, referring freely. When it appears in the object complement clause of a sentence, PRO is bound in that sentence, and hence cannot refer freely, as shown in (b):

(37)

- a. [To behave oneself in public] would help Bill.
- b. *John asked Bill [PRO to behave oneself]

2.5.2.1 Control into Adjunct Clauses

The vast majority of the discussion in the literature on control is focused on control of PRO in complement clauses. The theoretical status of control of PRO into adjunct³⁶ clauses is, accordingly, even less clear. The facts, however, are clear enough. The subjects of nonfinite verbs in adjunct clauses appear to demonstrate obligatory control by the closest c-commanding subject, wherever possible. An

³⁶ The sense of adjunct intended here is that of a modifying constituent which, unlike a complement, is not specified the θ -grid of a head.

example is the rationale clause³⁷ in (38). As shown by the limited choice of reflexives in (38), *I* is the only possible antecedent for PRO in this sentence, even though the sentence would have been more plausible had it meant that the first person subject bought the presents for **them** to amuse themselves (Chomsky, 1986):

- (38) They thought I bought the presents [PRO] to amuse myself/*themselves/*oneself.

Jones (1985) argues that rationale clauses and purpose clauses are both adjuncts, differing in the levels at which they adjoin: purpose clauses, as in (39) (a and b) are VP internal, while rationale clauses, as in (c), are VP external:

- (39)
- a. They brought John along [to talk to].
 - b. They brought John along [to show them the way].
 - c. They brought John along [(in order) to talk to him].

Purpose clauses can be one of two types: what Jones calls an object purpose clause (39)a is, under his analysis, a simple VP, while a subject purpose clause (39)b is a bare S

³⁷ There is some confusion about the appropriate terminology for this and similar constructions. I will adopt here the terminology of Jones (1985): any clause which is introduced by a 'to' that can be paraphrased with the words 'in order to' is a rationale clause.

(INFL in the current framework)³⁸. The difference between these two is that in (a) the controller is *they*, while in (b) the controller is *John*. Of the three types in question, only the rationale clause (c) is a full S'. In a purpose clause, unlike a rationale clause, there is an obligatory EC which is obligatorily controlled.³⁹

Similarly, based on the unacceptability of (40)a, it is seen that the preverbal temporal adjunct is c-commanded by the matrix clause⁴⁰. It follows from this c-command relationship that the PRO in (a) is controlled by *John* and the PRO in (b) is controlled by *Mary*. PRO, being coreferential with *Mary*, cannot be coindexed with *himself*, so (40)b is unacceptable due to a Principle A violation. This is in contrast with (c).

³⁸ Our discussion here will be limited to the subject purpose clauses, as the gap in the object purpose clause is not what is standardly considered to be PRO.

³⁹ This contrast in obligatoriness of control is analogous to a contrast in binding in different classes of PPs. Reinhart (1981) proposes that while some preverbal adjuncts are sentential, others are verb-phrasal. In her analysis, the former are attached to S" (IP in the current framework), the latter to S' (I'). In the following examples, i. is unacceptable because *Ben's*, an R-expression, is bound by *he*, unlike in ii.:

- i. *In Ben's office, he placed his brand new brass bed.
- ii. In Ben's office, he is an absolute dictator.

The Principle C violation in i. shows that the preverbal PP adjunct in i. is c-commanded by the matrix clause, i.e., in Reinhart's terms, verb-phrasal, while that in ii. is sentential.

⁴⁰ Huang (1989) gives an alternative account for these facts, whereby the adjunct, although it is attached to S" at S-Structure, was base-generated postverbally with the following structure (i), at which level it is subject to his theory of control:

- i. [s ... [s' [s PRO ...]]]

- (40)
- a. *After PRO working in John's office all day, John felt tired.
 - b. John reported that after PRO exhausting himself at work, Mary felt tired.
 - c. John reported that after PRO exhausting himself at work, Bill felt tired.

So we can conclude so far that the PRO subject of gerundive adjunct clauses is, like that of complement clauses, interpreted as referentially dependent on the main clause subject, and cannot be controlled by the direct object, which does not c-command it, as shown in (41) (a-b). In this respect PRO contrasts sharply with overt pronouns, as in (c):

- (41)
- a. John_i criticized Bill_j while PRO_{i/*j} giving the lecture.
 - b. Juan_i criticó a Maria_j PRO_{i/*j} presentando la charla.
 - c. John_i criticized Bill_j while he_{i/j} gave the lecture.

This restriction on interpretation of PRO is maintained even if the adjunct clause is preposed, as in (42):

The rule of obligatory subject control holds even if plausibility militates for object control:

Sometimes PRO in a gerundive adjunct appears to be controlled by an NP not even mentioned in the root

- (42)
- a. While $PRO_{i/+j}$ giving the lecture, $John_i$ criticized $Bill_j$.
 $PRO_{i/+j}$ presentando la charla, $Juan_i$ criticó a $Pepe_j$.
 - b. * PRO washing himself, Mary admired John.
 * PRO lavandose $_i$, Maria le admiró a $Juan_i$.

- (43)
- Jeff squeezed Rita's hand in the delivery room.
- a. !!While PRO_i giving birth, he_i watched her_j .
 - b. *While PRO_i giving birth, he_j watched her_i .
 - c. !! PRO_i dando a luz, $él_i$ le $_j$ miró.
 - d. * PRO_i dando a luz, $él_j$ le $_i$ miró.

sentence, but drawn instead from the preceding discourse, as seen in (44):

- (44)
- Jill was busy making plans for Mariel's birthday celebration. Being a perfectionist, there were lots of details involved.

This can be accounted for if we allow that adjunct control can be either of two kinds: predicate control or logophoric⁴¹ control (Williams, 1991). Under logophoric control, there is no locality condition and no c-command requirement. In logophoric control, the controller NP is the logophoric center of a sentence. To be a logophoric

⁴¹ According to Sells (1987) logophoric phenomena are a result of the interaction of the following notions: "the source of the report, the person with respect to whose consciousness (or 'self') the report is made, and the person from whose point of view the report is made".

center an NP must denote an entity with the qualities appropriate to being a thinker or perceiver, whose thoughts or feelings about the world are reported by the sentence; hence the contrast between (45) (a and b), an example from Williams:

- (45)
- a. PRO_i Having just arrived in town, the main hotel seemed to Bill_i to be the best place to stay.
 - b. *PRO_i Having just arrived in town, the main hotel collapsed on Bill_i.

Bill is attributed the qualities of a perceiver in (45)a by being the one to whom the hotel *seemed* a certain way. In (45)b, however, there is nothing in the sentence that marks *Bill* as a perceiver, so *Bill* is not available as the logophoric center.⁴²

PRO cannot be controlled by an expletive (i.e. non-referential) NP, so when the subject of the matrix clause is an expletive, PRO can be coreferent with some other NP;

⁴² Williams' analysis of logophoric control, discussed above, was inspired by that of Reinhart and Reuland (1991), who argue that logophoricity can account for local binding of a reflexive anaphor just when the anaphor is not on the θ -grid of the verb. They give the following examples by way of illustration:

- i. Apart from myself only three members protested.
- ii. Physicists like yourself are a godsend.
- iii. *She gave myself a dirty look.

In i. and ii., the SELF anaphors are in adjuncts, i.e. a position that is not on the θ -grid. In iii., by contrast, *myself* occupies a position on the θ -grid of *gave*. This precludes a logophoric interpretation, so *myself* must be a 'nominal' reflexive. In that case there is a violation of Principle A, assuming the complete functional complex as the relevant binding domain.

in (46)a PRO corefers with the indirect object *Bill*, an available logophoric center. By contrast, there is no available logophoric center in (46)b, which is only marginally acceptable:

- (46)
- a. It seemed cold to Bill_i, giving PRO_i the lecture.
 - b. ?It was cold, giving PRO_i the lecture.

To sum up: PRO needs a controller in order to acquire Phi-features and be interpretable. If and only if this controller cannot be found in an appropriate structural position⁴³, it can be sought in the discourse context;⁴⁴

⁴³ There is of course an NP subject of the matrix clause in (45), but a sentence in which *the main hotel* was coindexed with the subject of *having just arrived in town* would be semantically strange. If the subordinate verb is one that is semantically congruent with *the main hotel* as its subject, that matrix NP is indeed available as the controller, as shown in i. This is true even if there is a logophoric center available, as shown in ii:

- i. PRO_i Having just been built, the main hotel_i collapsed on Bill.
- ii. PRO_i Having just been built, the main hotel_i seemed to Bill the best place to stay.

⁴⁴ As suggested by R. Kayne (personal communication), the apparent exceptions, marginal as they are, all appear to be cases of control from an implicit argument, such as from a hidden dative:

- i. Walking down the street, it began to rain (on me).

Another example of such 'hidden' controllers, permissible in Spanish but not in English, comes from Culicover and Wilkins (1986):

- ii. {Permitió /Recomendó /Escuchó} lamentar.
permitted /recommended /listened to to lament
*S/he {permitted/recommended/listened to} (to)lament.'

Here the agent of the embedded verb is interpreted as being coreferent with the object of the matrix verb. Culicover and Wilkins (not working within a GB framework) use this example to argue that control facts are expressed at 'R-structure',
(continued...)

logophoric binding of PRO appears to be possible as long as there is an available logophoric center.

⁴⁴(...continued)

where thematic roles are represented, and not syntactically; English and Spanish differ in that only the former requires syntactic antecedents, which correlates with its syntactic requirement for subjects.

CHAPTER 3

MODULARITY ISSUES IN THE PROCESSING OF PRONOMINALS

3.1 Introduction

Chapter 2 presented a review of the syntactic background motivating the experimental research that will be presented in Chapter 4. The current chapter will review the sentence processing literature that provides the methodological background and justification for that research. Section 3.2 will review the method, measurements, and general logic of interpretation of results for the cross-modal priming (CMP) experimental paradigm and Section 3.3 will review one study from this paradigm that has used it to examine coreference processing of pronominals. Section 3.4 will review the details of two studies in the literature which use conflicting evidence from the coreference processing of null subjects to argue for or against the modularity of language processing.

3.2 Cross-Modal Priming (CMP)

The cross-modal priming (CMP) paradigm has been employed productively in two different types of studies. The methodology was originally developed (Swinney, Onifer, Prather and Hirshkowitz, 1979; Swinney, 1979) as a means of

studying the processing of lexical ambiguity. The task has been extended, in a growing number of studies, to reflect the interpretation of referentially-dependent nominals, overt as well as phonologically null¹. The CMP technique attempts to tap the ongoing processing of the language stimulus, as distinguished from post-perceptual processing. This is an essential prerequisite for any experiment assessing claims about the modularity hypothesis, which distinguishes between the automatic processes of the module and the higher level cognitive processing of the module's output.

With the CMP experimental technique, participants watch a video monitor while listening through a headset to prerecorded sentences. At some point during the auditory presentation of each sentence (or other experimental item) a word is flashed briefly on the screen. In some experiments the task is to press the key marked 'yes' if the target is a word and the 'no' key if it is not (lexical decision task). In other designs the task is to say the word aloud (the naming task). The aural stimulus does not cease on presentation of the visual stimulus, but continues on to some experimentally irrelevant but contextually acceptable completion of the sentence. The interval between presentation of the visual target and the

¹ For detailed review of these studies, see Fodor, 1989; Nicol and Swinney, 1989.

onset of the participant's response is measured and saved by the computer.

In studies examining the influence of plausibility on lexical access, two target words are tested, each of them a high semantic associate² to one or the other sense of a polysemous word that has appeared in the sentence. Response times to each of the targets are compared with those to an unrelated (control) target. Significantly faster response times to the related word are interpreted as evidence of facilitation. Such facilitation, or 'priming', is understood to indicate that the processor has accessed the particular sense of the polysemous word that is associated with the target word. There is evidence (e.g. Swinney 1979; Seidenberg *et al* 1982) for the access of multiple meanings of a polysemous word, regardless of pragmatic clues in the sentence or discourse, providing support for an informationally encapsulated lexical access process.

On-line experimental techniques can be employed to examine the behavior of the language processor while the linguistic stimulus is being received. The spoken language data are received by the perceiver in a linear fashion, and this research assumes that the processor is building a

² Semantic associates of a word are other words that often co-occur in a discourse, with the result that subjects tend to offer them in response to a request for a related word. Examples of high associative pairs are doctor/nurse, baker/bread, clock/time.

structural representation of the sentence in a left-to-right fashion, as it receives the data. When a referentially-dependent NP is encountered in the input, the coreference processor will, it is hypothesized, proceed to coindex that NP with its antecedent, respectful of all relevant grammatical principles. Identification (i.e. coindexing) of the incoming NP will involve the re-activation of its antecedent by the processor.

In CMP studies examining antecedent reactivation, only one related (associate) probe word is needed to test for reactivation of any given NP. Though most studies have presented a semantic associate as the target, recent studies (e.g. Fodor *et al*, 1994, and the experiments in Chapter 4 of this thesis) have used identity probes, i.e. the same word that appeared previously in the sentence as the antecedent. For obvious reasons identity probes can not be used in an experiment studying access of the multiple senses of a word. There is, accordingly, some unavoidable variance in relative degree of associative strength between the probes and the words whose priming facilitates their access. In antecedent access studies the use of identity probes can eliminate some of the noise in the data that is due to this variance.

In an antecedent reactivation study, facilitation can be measured in different ways, depending on the experimental design. Response time to a target related to

or identical to a potential antecedent is usually compared with the 'baseline' response time to a neutral control target of the same length and frequency. Facilitation would be indicated by a significantly shorter response time to the related target than to the control target. Another form of baseline is provided by probing at another position in the sentence, prior to the appearance of the referentially dependent element (but safely far from the antecedent). Yet a third baseline can be gotten from probing in a similar sentence with no anaphoric elements. Facilitation of the referentially-related probe would be indicated by shorter reaction times following the anaphoric elements than in other positions. Either way, facilitation is interpreted within this paradigm as reflecting the activation of the antecedent by the coreference processor; this activation is the processor's reaction to a referentially dependent element. Semantically associated words are activated coincidentally in this access process.

Various studies have shown that a referentially-dependent NP in the stimulus acts as a catalyst for priming. The combined results of these studies suggest that when an antecedent is uniquely selected by the syntax, there is priming by that NP and only that NP (Swinney *et al* 1988 for *wh*-trace; Nicol 1988 for reflexives); when there is syntactic ambiguity as to the antecedent, then all

potential referents are re-accessed, without regard to real-world knowledge (Nicol 1988 for object pronouns).

In the following section, by way of example, reviews one of the studies in the literature that has used CMP to look for antecedent reactivation by base-generated NPs.

3.3 CMP and Coreference Processing of Pronouns

Nicol (1988), using CMP, tested sentences like (1), contrasting reflexive anaphors with nonreflexive pronouns. (Note that the probe positions are indicated here by the symbol '*', and that this procedure will be followed through the dissertation.)

- (1)
- a. The boxer_i told the skier_j that the doctor_k for the team would blame him_{i/j/*k} * for the recent injury.
 - b. The boxer_i told the skier_j that the doctor_k for the team would blame himself_{*i/*j/k} * for the recent injury.

Target words: a) FIGHT/CLAIM (boxer)
 b) SLOPE/TOAST (skier)
 c) NURSE/LODGE (doctor)

Facilitation here was indicated by shorter reaction times to the related probes relative to their respective control probes. Crucially, there was facilitation of both *fight* and *slope* in (a) but of only *nurse* in (b), i.e. by all and only the grammatically appropriate antecedents available in the discourse, in accordance with the binding principles.

Nicol interpreted these results as reflecting on-line selection by the coreference processor of the grammatically appropriate antecedent for the two different classes of referentially-dependent elements. This evidence for **selective** antecedent priming by pronouns and reflexives suggests that the processor makes immediate use of syntactic principles - specifically the binding principles. Given this background of priming by base-generated NPs in accordance with the binding principles, and given that the same linguistic principles apply to phonologically empty categories, we would also expect to find evidence of antecedent priming by the base-generated anaphoric pronominal PRO and pronominal *pro*.

3.4 Null Subjects and the Modularity Hypothesis

I turn now to a set of experiments that were designed to assess the effects of pragmatic plausibility on the processing of base-generated pronominals. After a brief review of some relevant findings about overt pronouns, our focus will be set on two studies that have compared pragmatic effects on the processing of overt pronouns with pragmatic effects on processing of the null subject PRO of gerundive verbs.³

³ It is interesting to note that in neither of these studies did the authors refer specifically to PRO, preferring the more generic term 'implicit subject.' This dissertation having spelled out explicitly the implications of GB theory, I will posit
(continued...)

3.4.1 Against Modularity

Marslen-Wilson and Tyler (1987) reported experimental data which suggest that pragmatic implications drawn from the discourse are used parallel with, and as rapidly as, syntactic clues in the assignment of an antecedent to the pronominal subject of a verb. In the methodology used, which I will call the *fragment completion task*, participants heard a sentence fragment and then, immediately afterward, saw a word displayed on the screen. In some cases this word was a grammatical completion of the auditory sentence fragment. The participants' task was to read the word aloud as quickly as possible, and the interval between the onset of the visual presentation and the participant's response was timed.

In this experiment, each fragment was introduced by a one-or-two-sentence discourse, which I will call the 'context'. The context establishes a scene in which there are two human characters whose nature or behavior is distinct in some clear fashion. An example, concluding with its fragment, is given in (2). Two target words were tested, one compatible with the pragmatic bias introduced in the context and the other incompatible with it.

³(...continued)

the EC, PRO, as subject of each of these nonfinite verbs, and will represent it, accordingly, in the presented materials.

(2)

As Philip was walking back from the shop he saw an old woman trip and fall flat on her face in the street. She seemed unable to get up again.

(PRO) Running towards ...

Target words: HER, HIM

Naming latency to *him*, the pragmatically incompatible target word, was significantly slower than latency to *her*. The reason for this difference, according to the authors, is that immediately upon having heard the word *running* listeners made use of the pragmatic implications of the verb and the context to assign *Philip* as subject of the gerund. Such an assignment would make *him* an inappropriate continuation of the fragment. It is particularly striking that this effect with PRO was not significantly weaker than when fragments contained **overt** subject pronouns, as in (3):

(3)

As Philip was walking back from the shop he saw an old woman trip and fall flat on her face in the street. She seemed unable to get up again.
He ran towards ...

Target Words: HER, HIM

The conclusion drawn by Marslen-Wilson and Tyler from this pattern of results is that pragmatic inference is approximately equivalent in its effectiveness for disambiguation to that of the gender disambiguation provided by overt pronouns. Recall (Section 2.5.2) that

according to GB theory the implicit subject in the gerundive fragment is PRO, bound to its controller in the matrix clause. In these sentences the controller does not appear until later in the sentence, after the presented fragment stops. Therefore the use of plausibility to determine the antecedent for PRO demonstrates the use of pragmatic inference **within** the domain of the grammar. This, we assume, is what is prohibited by the modularity hypothesis.

Although these data seem at face value to undermine the modularity hypothesis for language, there are several serious flaws in the materials and design of the study which should temper this conclusion. For instance, as noted by Fodor, *et al* (1994), fully half of the experimental items presented only one animate referent in the introductory sentence. Each of the potential antecedents had a proper name that was lexically stipulated in English as being masculine or feminine, and never was ambiguous. Of the two pronouns tested, one was masculine and the other feminine. It follows that, in a context where there was only one referent, only one of the two pronouns could find an appropriate antecedent in the context. A relevant example, from the experimental materials, is given in (4):

(4)

As John was walking home, he realized that he didn't have his door-key. Searching through...

Targets: HIS, HER

In an item like this, the inappropriateness of *her* as a fragment completion could be caused by the lack of an available gender-matched antecedent for the possessive pronoun.⁴ Gender agreement of a pronoun with its antecedent is a grammatical requirement⁵, so it is not at all clear that the effect in these cases was induced by an assignment of an antecedent to PRO. It could simply be a reflection of the fact that *her* needs an antecedent that cannot be located in the discourse.

A second problem is that *her* is lexically ambiguous. In (5), for example, with the continuation *her*, the experimental assumption is that *her* will be parsed as an

⁴ Badecker and Straub (1992) showed that self-paced reading times following a pronoun are faster when there is a gender-matched antecedent in the sentence than when there is not; "John mentioned that he was late for class" is read more quickly than "John mentioned that she was late for class." While the materials discussed here are intersentential, it is reasonable to expect that the Badecker and Straub findings would extend to these examples, where there is not any gender-matched antecedent even in the preceding sentences.

⁵ In a language like English, which has weak syntactic gender agreement, it is not clear what the status of this agreement is in the grammar. (This issue will be addressed again in Section 5.5.) Nonetheless, no-one (and crucially not Marslen-Wilson and Tyler) has argued that it is not part of the grammar, at least at the level of semantics. It is equivalent, in fact, to the agreement required by the overt subject pronoun, which is the condition they use to show how fast differential effects are when they are grammatically induced.

object pronoun, not as a possessive pronoun.⁶ But a possessive reading is perfectly possible. Consider the example in (5):

- (5) As they were walking home through the wood, Clare noticed with alarm that a large rotten branch was about to fall onto Sam's head. She realized that she had to act quickly. Shouting loudly at HIM/HER...

Assume for a moment that the processor has indeed selected Clare as the shouter. Who would she be shouting at? One perfectly plausible object would be *her companion (friend, brother, etc.)*. Recall that the authors' interpretation of the advantage for the 'consistent' completion is that it is due to a processing overload and need for reanalysis on encountering the 'inconsistent' completion, where the inconsistency is with the assignments already made before that point. But the fact that there is a perfectly grammatical continuation after *her*, consistent with *she* being the one doing the shouting, poses a problem for this interpretation. Note that Marslen-Wilson and Tyler cannot argue that the possessive reading is disfavored by the processor, because they crucially rely on that reading in items like (5).

One further problem is the existence of a structural ambiguity in the test sentences. Note Marslen-Wilson and

⁶ This itself is objectionable, since the ambiguity could lead to an increase in processing load and, consequently, slowed responses. Furthermore, there is an imbalance between *her* and *his* in that the latter is not ambiguous.

Tyler presuppose that the perceiver will assign the pronoun an antecedent that is explicit in the discourse. In all the experimental materials there were at most two people in each discourse domain. However, there are at least two other possibilities that give rise to an ambiguity in the materials. The test sentence could be construed as a presentation sentence introducing a new referent into the context, as in (6)a. Alternatively, the test fragment could be the beginning of a statement about the feasibility or nonfeasibility of the old woman running, as in (6)b:

- (6)
- a. Running towards him was the woman's frightened dog.
 - b. Running towards him would have been utterly impossible for her.

Marslen-Wilson and Tyler's interpretation of their results does not take account of this. It assumes that the difference in latency at the object pronoun reflects the necessity, under the implausible condition, of reversing the assignment that has already been made to the antecedent of the subject PRO. But to make this convincing, they would need to give evidence that the intended *Philip running* interpretation of (2) (and other sentences in the experiment) is significantly favored by perceivers over readings as in (6)a and (6)b. It is not clear that this is so.

Even setting aside the ambiguity of the materials, an alternative account of the experimental results (Fodor et al, 1994) would be that the search for an antecedent is normally triggered by encountering an overt anaphoric element in the speech stream. In this experiment the probe itself is a pronoun that must be integrated into the ongoing sentence, and by Principle B the parser knows that it must be disjoint from the subject in its clause. Therefore it needs to know the reference of the subject of the clause, i.e. of the PRO. Because this task requires the incorporation of a pronoun into the context it is not possible to tap the on-line comprehension processes without very likely influencing them with the task itself.

In sum: while it is possible that Marslen-Wilson and Tyler's results may imply contextual/interactive effects on the naming task, there remain important questions to ask about the nature and locus of such effects along the course of sentence processing. The evidence provided is insufficient to distinguish between the intervention of pragmatic factors in the syntactic module and the effects of their influence occurring only after syntactic operations have been completed.

3.4.2 Testing the Immediacy of Pragmatic Effects

One of the weaknesses inherent in the fragment completion task is the inability to precisely determine the source for

the reaction time difference. The cross-modal priming paradigm provides a way to more closely track the course of antecedent priming. With this task, there is no need to wait for a resolution point at which to look for overload. If referential assignment is made immediately upon encountering a pragmatic clue, then at that point - immediately after the verb in these examples - there should be priming for only the pragmatically preferred subject.

Using materials closely modeled on those of Marslen-Wilson and Tyler (1987), Fodor *et al* (1994) used cross-modal priming to examine processing of PRO. The Marslen-Wilson and Tyler experimental design required the presence in the stimuli of object pronouns, which served to indirectly disambiguate the antecedent of the subject. Because of the greater flexibility of the cross-modal priming paradigm, Fodor *et al*, were able to avoid the potentially confounding presence of additional referentially-dependent elements. An example stimulus set is given in (7). The first probe point, near the end of the contextual lead-up, provides a baseline against which to compare the effects of the pronominals at the second and third probe points. Activation of an auditorily presented lexical item will generally decay after approximately four to seven words (Tanenhaus, Carlson and Seidenberg, 1985). The test position in (7) is considerably further downstream from *the fireman*, so it can be inferred that a facilitation

effect at the test position will indicate the re-activation of the antecedent by the processor, and not simply a residual priming effect.

(7)

The fireman carried a rope toward the little girl who was trapped on the ledge, immobilized with fear. He moved very carefully.

- a: He crawled cautiously * toward her * so he could hand her the rope and save her.
- b: PRO_i Crawling cautiously * toward her * so that he could hand her the rope, he_i managed to save her.

Targets: FIREMAN/GIRL

The second probe point was the earliest test position at which an effect of PRO might be observed; it was placed immediately following a postverbal adverb, i.e. after *cautiously* in (7). In the overt pronoun condition (a), the naming response to *fireman* (but not the response to *girl*) was significantly faster at this position than at the baseline position, showing activation of the only grammatically legitimate antecedent for *he*. In condition (b) with PRO, however, there was no change relative to baseline in the response times for either of the antecedents, i.e. no indication of a priming effect for the antecedent of PRO, despite the contextual clue that had been provided by the verb.

The third and final probe was following the object pronoun, in a position comparable to Marslen-Wilson and

Tyler's (1987) test position. Response times at this third position, relative to the previous one, showed facilitation only in the PRO condition, for both *fireman* and *girl*.

Fodor *et al* attribute this effect to a parsing strategy by which antecedent assignment to a 'zero pronoun' (i.e. PRO) is delayed until the appearance of some kind of grammatical trigger. One such trigger, it is proposed, would be an overt anaphoric element, which would function as a catalyst for assignment of NPs to the entire theta grid of the verb.

Fodor *et al.*'s findings, with a clear divergence of results for *he* and PRO, are clearly incompatible with the interactive model proposed by Marslen-Wilson and Tyler. They suggest, instead, that pragmatic influences from the previous discourse are not sufficient to assign an antecedent to PRO when a grammatically assigned antecedent is yet to appear in the sentence. The only condition in which there was differential facilitation of the pragmatically plausible antecedent was when plausibility favored the same antecedent as did the discourse focus and agreement features (gender, number, and person) of the overt pronoun. The critical condition for Marslen-Wilson and Tyler's argumentation, that of PRO, fails to show any differential contextual effect.

CHAPTER 4

PROCESSING OF NULL SUBJECTS IN SPANISH: DIFFERENTIAL
EFFECTS OF PRAGMATIC PLAUSIBILITY**4.1 Introduction**

There are important issues regarding mental architecture which cannot be resolved without empirical evidence as to the conditions under which pragmatic information is used by the processor. The assignment of antecedents to null subjects is one specific phenomenon that can be exploited to attain such evidence. The data to hand, as discussed in Chapter 3, suggest that some version of the cross-modal priming technique could be useful in determining which antecedents are actively in play at any given point in the on-line processing of a sentence. At least one experiment carried out under this logic (Fodor *et al*, 1994) suggests (contra Marlsen-Wilson and Tyler, 1987, with a different technique) that a pragmatically disambiguating clue does not pick out the antecedent of a subject in the same way that a syntactically disambiguating clue (an overt pronoun) does.

There is a problem, however, in that Fodor *et al*'s finding is due to the difference between syntactically and pragmatically disambiguating clues. Given the grammar of English, the syntactic contrast between a controlled

anaphor (PRO) and a full pronoun is inevitably confounded with a difference in the acoustic reality of the element. Processing differences between PRO and overt pronouns might be due to the different syntactic constraints to which they are subject (as a controlled anaphor vs. a locally free pronominal), or they might be due to the mere lack of acoustic evidence in the case of the first compared with the positive evidence provided by the acoustic qualities of the second. It might be that, because an EC cannot be directly perceived, syntactic constraints (e.g. the Extended Projection Principle, see Chapter 2) must be accessed and applied in order for the parser to establish the presence of an EC in the input, and that these computations delay or interfere with normal effects in pronominal interpretation.

An opportunity to disentangle those potential factors is provided, in Spanish, by the possibility of comparing processing reflexes in the context of PRO with those in the context of an empty category that is a free pronominal, namely *pro*. As a reminder of the syntactic issues at stake here, Section 4.2 will briefly recap the issues (discussed in detail in Chapter 2) that are relevant to the contrast between PRO and *pro*.

4.2 *pro* versus PRO: two kinds of null subjects

Being a 'null subject language', Spanish permits as the subject of a finite verb the phonetically-null counterpart to overt pronouns known as *pro*. In addition, Spanish, just like English, has as the subject of a nonfinite verb the pronominal anaphor PRO. This pair of facts offers an opportunity to compare two null elements that appear in roughly comparable surface strings, yet differ in their syntactic status. On the phonetic level, the only difference is that in a clause with *pro* the verb is inflected for tense and Phi features (person and number, in Spanish), while in a clause containing PRO the verb is not inflected for any of the three. The stimuli prepared for the experiments to be presented here will contrast *pro* with PRO in preposed adverbial clauses.

Pro, exactly like overt pronouns, is subject to Principle B of the binding theory, which states that a pronoun must be free in its governing category. For all relevant purposes, this means simply that a pronoun cannot have an antecedent within the same clause. The theory makes only this negative statement about the referential indexing of any pronoun. Thus, in contexts in which Principle B fails to limit the set of possible antecedents to one, a pronoun is free to find its antecedent in the previous discourse. *Pro*, like any other pronoun, is

syntactically free¹ to pick any discourse referent with appropriate Phi features. Whatever procedure is involved in the choice of interpretation for pronouns, no sentence-grammar rule of coreference is involved.

Like *pro*, PRO is an abstract syntactic element with no phonetic content. PRO, however, is not a pure pronoun but a pronominal anaphor. In order for it to have other than arbitrary reference, it must inherit its Phi-features from its controller, another NP with which it is coindexed, and it must be coreferential with that NP.

When PRO is the subject of a subordinate adverbial clause it is antecedent-controlled by, and co-indexed with, the subject NP of the main clause. This holds true even when, as in our experimental sentences, the adverbial clause is preposed so that PRO linearly precedes its 'antecedent.' Consider the difference in acceptability between (a) and (b) when following the introductory sentence in (1):

- (1) Mary and John held hands in the delivery room.
- (a) PRO smiling through the tears, he kissed her.
- (b) ??? PRO giving birth, he kissed her.

¹ Because of the absence of quantifiers and *wh*-operators in the experimental stimuli, it is reasonable to overlook here the cases where *pro* is interpreted as a bound (i.e not free) variable.

In (a), which is perfectly acceptable, the one doing the smiling (PRO) must be coindexed with *he*. The smiler, therefore, is understood to be the person named John, the only NP in the discourse that can be coindexed with the masculine singular pronoun *he*. In (b), again, the control facts require PRO to be coreferential with *he* and hence with *John*, but the sentence is anomalous because it would mean that *he* was giving birth.

4.2.1 Implications of the Contrast

Given the same discourse and comparable sentence structures, a processor that respects the encapsulation of syntax should treat PRO and *pro* in distinct manners, since one has a syntactic controller in a fixed place in the sentence while the other is free to select its antecedent from the sentence or in the discourse, though not from within the local domain. In our experimental stimuli, the adjunct clause in which the pronominal occurs has been preposed, so that PRO actually linearly precedes its controller, which has yet to appear when the processor encounters PRO. *Pro*, on the other hand, **may** be coreferential with the subject of the matrix clause, but there is no syntactic principle requiring that. In (2)a, for example, the *pro* subject of *bailaba* in the preposed adverbial clause corefers with the *pro* subject of *se sonría* in the matrix clause, but in (2)b it does not:

- (2)
- a. Rita_i mostraba bastante talento. Mientras pro_i bailaba, pro_i se sonría.
'Rita showed plenty of talent. While pro_i danced, pro_i smiled.'
 - b. Rita_i mostraba bastante talento. Mientras pro_i bailaba, Sara_j se sonría.
'Rita_i showed plenty of talent. While pro_i danced, Sara_j smiled.'

The main question to be addressed in the experiments that follow can now be formulated in this way: In such constructions, does *pro* behave like PRO or like an overt pronoun?

While the licensing in Spanish of both *pro* and PRO provided cases which contrast in important ways for the modularity argument, there were, as always, a great number of decisions to make concerning the experimental design and materials construction. Leaving aside, for the moment, the details of how these decisions were made, the following is an introduction to the basic design that was selected for this project, concluding with an example (on page 84) that illustrates the desired design features.

The spoken material for each item would be a semantically coherent pair of sentences (labeled S1 and S2 for purposes of exposition here). S1 would introduce two human characters, differentially marked for gender, who would be available in the discourse as potential antecedents for referentially-dependent nominals occurring in S2. S2 would begin with an adverbial temporal clause,

preposed and subordinate to the matrix clause². To create three basic experimental conditions, three versions of each S2 would be created: one with PRO, one with *pro*, and one with an overt pronoun as subject of the subordinate clause.

It was considered a prerequisite for a well-designed study to establish a priming benchmark for an antecedent, in this case of a subject pronominal, under any particular set of experimental conditions (Fodor, 1989). This design exploits the fact that Spanish has a set of overt subject pronouns, similar to the English paradigm, explicitly specified in the third person for number and gender, as shown in (3):

- (3)
- | | | | |
|-------|------------------|-------|------------------|
| él- | masc, sg, 3 pers | ellos | masc, pl, 3 pers |
| ella- | fem, sg, 3 pers | ellas | fem, pl, 3 pers |

Thus, when S2's subordinate clause has an overt pronoun, gender marking (feminine in half the items, masculine in the other half) would limit its antecedent to only one of the two humans introduced in S1, since these were marked

² The subordinate adverbial clause is one of the few in which a null and an overt pronoun are equally acceptable in the same context.

for distinct genders³. Thus the overt pronoun version could act as a benchmark, against which the other two conditions, in which the subject is a null pronominal, can be contrasted. For these latter, throughout the processing of the subordinate clause, there will be no syntactic disambiguation of the antecedent. The only locally available clue as to the appropriate antecedent will be a pragmatic one, driven by a bias for one of the discourse antecedents as the more plausible subject of the verb that appears in the subordinate clause. If there were less effect when the subject was PRO or *pro*, then that difference could be interpreted to indicate that the antecedent was not unambiguously determined by the pragmatics or perhaps that it was not even computed by the on-line comprehension routines.

The example given in (4) illustrates a discourse with all the properties outlined above. S1's human characters are *ingeniero* (the engineer) and *la estrella* (the star), marked male and female, respectively. S2's subordinate verb is *cantar* (to sing), which is pragmatically biased to

³ In a CMP experiment, Nicol (1988) found that following a masculine pronoun there was priming for only male referents. For the feminine pronoun, however, there was activation of all antecedents. This imbalance in the data patterns is easily accounted for by an imbalance in the materials. While two-thirds of the 'feminine nouns' had overt morphology marking them as exclusively feminine (e.g. *ballerina*, *governess*), the same was not true for the majority of the NPs considered 'masculine' in the experiment (e.g. *skier*, *baker*). Hence this imbalance in overt gender marking in English accounts for the imbalance in the results. In Spanish, by contrast, every NP is clearly marked for gender.

select *estrella* as its subject. The same verb, in its respectively appropriate form, occurs in each of the S2 versions, which are marked here as B ('big' PRO), L ('little' pro) and O (overt).

(4)

El ingeniero de sonido y la estrella famosa estaban preparados para la grabación del disco.

The sound engineer(masc) and the famous star(fem) were ready for the recording of the record.

(B) Cantando el tema musical del film más popular, causó buena impresión a todos los presentes.

PRO singing the musical theme of the most popular film, pro made a good impression on everyone present.

(L) Mientras cantaba el tema musical del film más popular, causó buena impresión a todos los presentes.

While pro sang the musical theme of the most popular film, pro made a good impression on everyone present.

(O) Mientras ella cantaba el tema musical del film más popular, causó buena impresión a todos los presentes.

While pro sang the musical theme of the most popular film, pro made a good impression on everyone present.

What is of interest is the presence of the pragmatic clue within the preposed subordinate clause. The issue at hand is whether the processor will make immediate pre-emptive use of that clue, under all three conditions, even though the syntactic controller for PRO, the (*pro*) subject of *causó* (made) is yet to appear. Therefore, we want to test,

in each version of S2, for reactivation of each of the potential antecedents, immediately after the verb that provides the clue. Questions concerning the probes appropriate to this end will be discussed below in Section 4.3.1.1.

4.3 Experiment 1

There are many design considerations in turning the broad-brush plan sketched above into a tightly controlled experiment. The material in Section 4.3.1 addresses the most troublesome of these.

4.3.1 Preliminary Design Considerations

4.3.1.1 Target Probe Selection

One aims, with CMP, to access the salience of potential antecedents at some specific point, determined by the experimenter, during the processing of the sentence. In this experiment, the selected point is immediately following the verb in the initial, subordinate clause of S2. At that point, there is a visual target presented, which is not part of the incoming sentence. The speed of processing of that target will reflect the presence or absence of support ensuing from the stream of sentence processing, at this particular point. These are the issues relevant to the selection of the appropriate target probe, performance task, and control.

Whereas the typical cross-modal priming paradigm employs semantic associates of potential antecedents as targets for either a lexical decision or a naming task, another possibility is to use identity probes: that is, the word presented visually is exactly the lexical item previously used to introduce a potential antecedent. As discussed in Chapter 3, Section 3.2, the identity relation has a fixed value, whereas semantic association is a variable-strength relation. For semantic association, then, there is an inevitable introduction of experimental noise, depending on whether materials selection has resulted in a stronger (e.g. *table/chair*) or weaker (e.g. *doctor/nurse*) instance; it is not usually possible to fix the strength of semantic relations. Further, as not every word has been tested, the use of available norms of associative strength imposes restrictions on the creation of the materials set.

Unlike most of the previous studies done in this paradigm, the present study, like that of Fodor *et al* (1994), looks for evidence of activation of extra-sentential antecedents. Given this consideration, a uniformly powerful prime is called for; Fodor *et al*'s use of identity probes proved successful in that it led to significant differential results. In addition, it was reasoned that the strength of identity would help to offset the weakness of previously obtained priming for PRO by

semantic associates (Nicol, 1988). Hence the combination of methodological considerations in this experiment selected identity nouns as the preferred target words.

For two reasons, naming of visual probes was preferred to a lexical decision task. First, it has commonly been argued (e.g. Seidenberg et al., 1984, among others) that the lexical decision task involves more post-perceptual processes than does naming, since it calls into play central decision-making processes.⁴ These processes might be facilitating the lexical decision response, thereby contaminating the latency measure, which is taken to be a measure purely of antecedent reactivation.⁵ Second, there was a purely logistical consideration: an experimental design employing lexical decision requires many more filler sentences than a naming task design, since it adds to a set of already complicated materials the cases - of no analytic interest - for which targets are nonwords.

⁴ There is some evidence that the lexical decision task is sensitive to thematic congruity, while the naming task is not (Boland, 1993). It might be questioned, then, why it should be expected that the naming task as used here would be sensitive to the influence of a plausibility bias. To the extent that there is any such bias effect observed in this experiment, there is evidence that the task can reflect the effects of at least some non-syntactic factors.

⁵ It is to be noted that despite its stated advantages over the lexical decision task, there are some potential problems associated with the naming task. It is difficult to be certain that when a participant articulates a word the word has actually been retrieved from his mental lexicon; there is always the possibility that the participant has merely pronounced a letter string. Differential data patterns revealed in the experimental outcome, however, suggest that this in fact is not happening.

The experimental targets, then, will be identity probes; it is the speed of performance with respect to the identity probes that is meant to signal whether, at the test point, the antecedent named is activated. But speed has to be measured relative to something else, so an appropriate control must be selected. Control probes were selected to be like the experimental probes in all relevant respects (except that they had not occurred already in the discourse). They were matched in number of characters, so that neither would have any advantage of being more easily visually perceived. The design inclusion of an overt pronoun condition requires, further, that they be of the same grammatical gender. And they should share the same phone class in their onset; the response time measurement taken is that of time elapsed between presentation of a visual target and the beginning of vocalization, and only such matching ensures that the rise-time of acoustic energy is the same in experimental and control cases.

Experimental targets are also standardly matched to their controls for occurrence frequency, which has been shown to affect the speed and accuracy of a word's recognition (Forster and Chambers, 1973 (for naming); Rubenstein, Garfield, and Millikan, 1970; Scarborough, Cortese, and Scarborough, 1977). In order to eliminate frequency-induced differences in response times, the usual practice is to match control words on the basis of their

frequency of occurrence estimated from printed corpora. For several reasons, however, the available published Spanish word frequency counts were deemed inadequate for the needs of this study. Most notably, the largest available source (Juilland and Chang-Rodriguez, 1964) may well be outdated with respect to contemporary usage. Despite its publication date, the source materials were all published between the two World Wars, approximately 50 years ago. Also, the sample is not large, being of 500,000 words, only half the size of the standardly employed English sample (Kučera and Francis, 1967).

Given these limitations of the published Spanish word frequency counts (some of which hold as well for the English sources, Gernsbacher, 1984), the matching of identity and control targets was not based on printed frequency estimates. Rather, initial selections amongst several length-matched candidates were guided by data gathered in an informally organized task that was undertaken by six native speakers. These informants were asked to rate each of a list of words for what they believed to be its relative frequency, on a seven-point scale.⁶ Additionally, via a word list naming task,

⁶ Kenneth Forster (personal communication) and colleagues have reason to believe, based on unpublished experimental data, that conscious ratings of frequency can be used as a technique for matching words. Gernsbacher (1983) found such 'experiential' familiarity of 455 words of low (printed) frequency to be highly reliable, with judgments showing a broad and well-distributed range of ratings, and close agreement among raters.

baseline naming latencies were acquired for all target words. (This task is described in Section 4.3.4 below.) These were later used to adjust reaction times collected in the main experiment, filtering out much of the noise that frequency and related factors can cause. Experimental data will, accordingly, be reported as BARTs: Baseline Adjusted Reaction Times.

4.3.1.2 Pragmatic Bias

The term 'pragmatics' is often used generically to refer to any kind of extrasyntactic information, but there is a relevant distinction to be made within this, among different sources of such information. The general world knowledge and attitudes of the language perceiver might be brought to bear on the analysis of some language stimulus. Other information might be gleaned from the organization of the current discourse. In this experiment the aim was to assess, specifically, the influence of the non-syntactic clues provided by the discourse, presupposing a typical listener's general beliefs about the world. As an example, in (4) (on page 84), when *the famous star* and *the sound engineer* are in the studio together, most people would expect the star to be the one singing. Accordingly, every attempt was made to avoid the presence of other potential influences on the choice of preferred antecedent, such as the occurrence of lexically associated words in the

discourse, or one NP being more focused in the discourse than the other. The effects of these, if present, would be confounded with the effects of interest, so it was important that they be minimized. Sections 4.3.1.3 through 4.3.1.5 will discuss the kinds of factors that were considered important to avoid in the experimental materials.

4.3.1.3 Avoiding Lexical Association

One possibly confounding influence to be avoided was the presence of pre-existing (semantic) associations between any pair of potential antecedents introduced in S1. Association of this kind opens up the possibility of one discourse antecedent activating the other, which could obscure any specific relation between S2's verb and the previous discourse. For this reason, materials construction never paired obvious associates like *el médico* 'the doctor' with *la enfermera* 'the nurse', or *el profesor* 'the professor' with *la alumna* 'the student'.

A second kind of pre-existing association to be avoided was that between the biasing verb in S2 and either of the potential antecedents in S1. If there were such an association, then the lexical entry for the verb itself, even out of context, might be expected to activate that antecedent. In order to be certain of avoiding this, a paper and pencil study was run to discover the nouns most

highly associated with the verbs that were intended for use. The subjects in this preliminary study were 48 high school seniors in Madrid who volunteered their participation. They were given a list of verbs in infinitival form, and were asked to write down the two types of person most likely to be agents of each of the verbs. The example given to them is shown in (5). Two examples from a form completed by a participant are given in (6):

(5)

MENDIGAR 'to beg'	_____	_____
DISPARAR 'to shoot'	_____	_____

(6)

MENDIGAR 'to beg'	<u>pobre</u> 'poor one'	<u>mendigante</u> 'beggar'
DISPARAR 'to shoot'	<u>policia</u> 'policeman'	<u>criminal</u> 'criminal'

Some verbs were found to have a very frequently selected agent. These came in two varieties: deverbal nominals (e.g., *cantar/cantante* 'to sing/singer') and morphologically unrelated pairs (e.g. *robar/ladron* 'to rob/thief'). Pair elements of the first type are likely to prime each other because they are derivationally (including semantically) related, and those of the second type because they are syntagmatic associates. The experimental

materials used only agents whose probability of selection was shown in the preliminary study to be less than 5%.

4.3.1.4 Avoiding a Discourse Focus Effect

At every position in a linguistic discourse there is usually one individual (or thing) which is particularly salient at that point in the discourse; this is known as the discourse focus. There is a general expectation, while processing language input, that the subject of the next verb will have as its referent the same individual that is currently the discourse focus (Marslen-Wilson, Levy, and Tyler 1982). All else being equal, one would assume a *star* to be more likely to be singing in the studio than an *engineer*; this is an example of the kind of pragmatic effect of interest in this experiment. If *the star* were also the current discourse focus, then there would likely be a confound of influences on antecedent activation.

When not confounded with any other influencing condition, discourse-based appropriateness has been shown to cause an effect equally as strong as those produced by pragmatic implications of the verb, or even of gender-disambiguating pronouns (Marslen-Wilson, Tyler, and Koster, reported in Marslen-Wilson and Tyler, 1987)⁷. It is

⁷ When crossed with the other two factors, however, the discourse focus effect was the weakest of the three, obscured by the availability of the other disambiguating clues.

important to distinguish pragmatic from discourse focus influence on priming, since the latter can be considered to be a grammatical constraint and therefore ought not be considered unquestionably a top-down influence on syntactic processing. Our materials, therefore, were created in such a way that there was no clear discourse focus. In order that the two individuals from the context sentence be equally focussed, they always appeared in S1 as a conjoined subject. This was further controlled for by having the plausible antecedent be the first-mentioned in half the materials, and the second-mentioned in the other half. In this way any possible confound of discourse focus with the pragmatically biased selection of subject was avoided.

4.3.1.5 Postverbal Subjects in Spanish

What information is available to the processor at the point at which the target probe is presented (immediately following the first verb in S2)? Given that verb's meaning, there is a pragmatic clue as to its more plausible subject. In the overt pronoun condition, the subject has been made explicit. In the other two conditions, although there has been no phonologically overt subject, there has been a phonologically overt verb, which, of course, requires a subject NP (cf. Section 2.2 on the Extended Projection Principle).

It must be noted that, although the canonical position for the subject is preceding the verb, there is a qualifying factor regarding the assumption that a subject NP in preverbal position will be posited by the processor once a verb has been passed. As mentioned in Section 2.5.1, Spanish allows the possibility of post-verbal subjects; given a tensed verb, there could be a grammatical continuation of the clause in which an explicit subject appears after the verb, as, for example, in (7):

- (7)
*pro*_i hablará Juan_i
 (*pro*_i) speak(future) John_i
 'John will speak'

Nonetheless, there is convincing evidence from Italian, which is similar to Spanish in all relevant respects, that the parser, when it has passed a verb that was not preceded by an overt subject, prefers the canonical subject-verb-object order (DeVincenzi, 1991). That is, lacking conflicting evidence, the processor posits a full preverbal *pro* subject. When, further along in the sentence, plausibility clues mitigate against the preferred parse and for a parse containing a post-verbal subject in a chain with an expletive *pro*,⁸ a garden path effect is

⁸ This does not apply to unaccusative verbs, whose canonical subject appears postverbally (Burzio, 1986; Belletti (1988). Such verbs were avoided in our experimental materials.

caused.⁹ These results demonstrate operation of the Minimal Chain Principle (MCP), namely a parsing preference for building the shortest possible syntactic chain at S-Structure¹⁰. As there is no conflicting evidence in our materials, it is fair to assume that the parser will posit a preverbal *pro* in the environment of a tensed verb.

A less well-known fact about Spanish is that it also allows postverbal explicit subjects in nonfinite clauses, as illustrated by the examples given in (8)¹¹:

⁹ DeVincenzi notes that because *pro* usually has a contextually provided antecedent (the discourse focus), and her materials were single sentences, the parser might have preferred a postverbal lexical NP. She predicts therefore that given an appropriate context there should be an even stronger preference for the *pro* subject.

¹⁰ It is tempting to see this principle as the parsing analogy to certain of the principles of the minimalist program in syntax. The notion of "shortest link" (Chomsky 1993), a principle guiding the formation of chains, has the consequence that for any given LF output, if there are two otherwise equally optimal chains, only the shortest chain will be permissible. Both full and expletive *pro* are permissible syntactic chains (presumably because they represent two distinct logical forms), so the parser cannot rely on the syntax to do all its work. It would, nevertheless, be parsimonious for it to take advantage of the grammar's preference for least effort.

¹¹ The relevant syntactic issues will be addressed in greater detail in Section 5.3.3.

- (8)
- a. Llegando Rita, Rolando se fue.
 - b. Al llegar Rita, Rolando se fue.
(Upon) arriving Rita, Roland left
'When Rita arrived, Roland left.'

Because this is less frequent and more highly stylized than postverbal subjects in finite clauses (Fernandez Lagunilla, 1987), there is an even smaller likelihood of encountering an explicit subject postposed after an infinitive than after a finite verb. Therefore it is reasonable to expect the MCP to operate as well in this context, preferring a preverbal PRO to a dummy PRO in a chain with a postverbal subject. Nonetheless, in order to add support to the intuition that this would be an unpreferred word order, a paper and pencil fragment completion task was performed. Twenty volunteers were presented with eight fragments taken directly from our experimental materials. S1 was presented completely and S2 was cut off right after the nonfinite verb. Nine fragments ending in tensed verbs were interspersed with those of interest in order to distract attention from the construction. (Instructions and tabulated results are given in Appendix A.)

Some examples are given in (9) to illustrate the different ways in which responses have been classified (the completed response is underlined). Only 8% of the completions had postverbal explicit subjects, as in (a). The most common kind of completion had PRO as the null

subject of the nonfinite verb (78% of total). These latter were of two designs; there was a roughly equal split between replies like (b), where the controller is also a null subject, and those like (c), in which the matrix subject is either an overt pronoun or a lexical NP:

(9)

- a. La ciega y el pintor fueron juntos a un nuevo restaurante en el centro de la ciudad. Leyendo la carta el pintor decidieron su menu.

'The blind woman and the painter went together to a new restaurant in the center of the city. PRO Reading the menu the painter, pro decided(pl) on their menu.'

- b. Ayer en la farmacia, la lavandera y el boticario se contaron las ultimas novedades del pueblo. Al final, despues de comprar aspirina, se fue a la lavanderia.

'Yesterday in the pharmacy, the laundress and the druggist recounted the latest town news. In the end, after PRO to buy aspirina, pro went to the laundromat.'

- c. El obrero y la inquilina convinieron ayer el precio del arreglo de la casa. Esta mañana, tras reparar los desperfectos, él pidio su sueldo.

'The workman and the tenant discussed yesterday the price of the repairs on the house. This morning, after PRO to repair the imperfections, he requested his salary.'

The results of this paper and pencil test confirm the observation that postposed explicit subjects following nonfinite verbs are rare. They show further that there is nothing in the experimental materials that favors the

appearance of postverbal subjects. We can expect, therefore, that the processor, once it has passed the verb, will posit a subject NP in preverbal position.

4.3.2 Predictions

The working hypothesis of this research is that the processor will respect the representational distinction between PRO and *pro*, even though they are both phonetically empty. Given the same discourse and parallel sentence structures, we expect to see differences in the treatment of PRO and *pro* that reflect the fact that the former, but not the latter, has a syntactic controller.

Pro is a syntactically free pronoun, and its antecedent can - indeed must - be found in the discourse. Since the ambiguity of its referent cannot be resolved by the syntax, there is no barrier to the immediate use of pragmatic clues. In contrast, PRO is a syntactically-controlled element. In an adverbial clause, it must be coindexed and coreferential with the subject of the root clause. This knowledge, that the antecedent for PRO is to be identified by the syntactic controller, we assume to be specific to the linguistic module. If the processor recognizes that this subject of a non-finite verb is an element that needs to be syntactically-bound, and if it is a modular processor, respectful of the encapsulation of this faculty, then we would expect it to make use of

this knowledge independently of the available extralinguistic clues.

Since the overt pronoun is gender-specific, there is only one human in the discourse that could be its antecedent. In all items tested, the morphological gender marking and the contextual plausibility select the same antecedent; hence we expected to see a significant effect of plausibility (confounded with the effect of gender agreement) in the overt pronoun condition. Thus the overt pronoun condition provides a baseline measurement for complete disambiguation of the antecedent; the data output patterns revealed by the overt pronoun will serve as a model for an antecedent activation bias.

We have seen then that at the probe position, the processor has heard both the pragmatic clue as well as evidence for an overt or silent subject pronominal. If referential assignment is made immediately upon the subject being encountered, and such assignment is based on the pragmatic clue, then naming times immediately after the verb should reflect activation for only the pragmatically plausible antecedent. Activation should reveal itself in reduced naming times for the identity targets for the plausible antecedents, relative to the control. Rather than directly comparing responses to plausible and implausible antecedents, the measure of activation of an antecedent was the difference between its latency and that

of its matched control. It is expected that a repetition effect will make BARTs for all identity probes faster than those for the control probes, since the latter are unrelated to anything in the discourse. Hence antecedent activation is to be seen in the comparison of the BARTs for plausible versus implausible identity probes, after they have been subtracted from the BARTs for their respective form-matched control probes. It is this interaction that will reveal the pure effect of plausible versus implausible antecedent.

4.3.3 Method

Participants. Sixty students at the Universidad Complutense de Madrid were paid the equivalent of US\$6 for their participation in the experiment. All were native Spanish speakers¹² with normal or corrected vision and no hearing loss¹³. Participants were informed that the experiment was part of a study of normal language processing.

Materials and Design. Experimental tokens consisted of two-sentence paragraphs, of which 48 were constructed. The

¹² It is next to impossible to find a university student in Spain who has not studied some English. Therefore it was not a requirement that the participants be monolingual. They all, however, consider Spanish to be their primary language.

¹³ This information was based on participants' subjective reports.

first sentence (S1) provided the context, introducing one male and one female human into the discourse, each referred to by a common noun¹⁴ identifying either an occupation (e.g., profesor 'professor') or human relation term (e.g., tío 'uncle'). Like every common noun in Spanish, these were marked for gender (feminine or masculine) by the accompanying definite article¹⁵. In order to minimize possible discourse topic effects, the two nouns formed the conjoined subject of S1. (10) and (11) provide examples of S1.

(10)

La arrogante millonaria y el huérfano abandonado
llegaron al mismo tiempo a la puerta del
restaurante.

The arrogant millionaire(f) and the abandoned
orphan(m) arrived at the same time at the door of
the restaurant.

In S2, the verb of the preposed subordinate clause was pragmatically loaded so as to select either the male or the

¹⁴ Some of these nouns, though not all, were modified by adjectives, which were used to strengthen the plausibility bias.

¹⁵ The gender of a noun is not always overtly marked, but it must agree with the gender of the determiner, which is always overtly indicated. Terms identifying humans have two lexical entries, one masculine and one feminine. In some cases, the feminine is marked by the suffix '-a' (e.g. *el doctor/la doctora*). In others, the masculine ends in '-o' and the feminine in '-a' (e.g. *el millonario/la millonaria*). In many cases the only overt difference is the determiner (e.g. *el estudiante/la estudiante, el dentista/la dentista*.) Given this lack of systematicity, as well as the limitation of the paradigm to human identity nouns, the relationship between masculine and feminine noun pairs is considered to be derivational, not inflectional (Harris, 1991).

(11)

La refinada condesa y el rufian grosero estaban
asomados al balcón del museo.

The refined countess and the gross ruffian(m) were
looking over the balcony of the museum.

female (equally rotated through items in the experiment) as its thematic agent, and hence as its subject.¹⁶ Beyond S2's verb, and for at least the next 10 syllables, no additional pragmatic bias was introduced, nor were there any clitics, pronouns, or additional verbs. Avoiding these elements ensured that at the immediately postverbal test point, and through the additional material which might be heard during performance of the task, there was no relevant change in the available contextual influence on the selection of the more appropriate agent.

Three different versions of S2 were constructed, corresponding to the three pronominal types which can appear in subject position in Spanish: PRO, *pro*, and overt pronoun. These subjects appeared in an initial subordinate clause, which was followed by a main clause that was identical in all three cases. The three S2 discourse completions for (10) and for (11) are shown in (12) (a-c) and (13) (a-c) respectively:

¹⁶ Order of mention, resulting in an advantage for first-mentioned participants, has been a significant factor in some antecedent reactivation studies (Corbett and Chang, 1983; Gernsbacher, 1989). Accordingly, the order of mention of plausible and implausible antecedents was alternated here.

- (12)
- a. Mendigando lastimeramente una comida caliente, se desmayó.
'(PRO) Begging sorrowfully a hot meal, (pro) fainted.'
 - b. Mientras mendigaba lastimeramente una comida caliente, se desmayó.
'While (pro) was begging sorrowfully a hot meal, (pro) fainted.'
 - c. Mientras él mendigaba lastimeramente una comida caliente, se desmayó.
'While he was begging sorrowfully a hot meal, (pro) fainted.'
- (13)
- a. Al escupir despiadadamente hacia el suelo, lanzó una carcajada.
'Upon PRO spitting[inf] despicably towards the ground, (pro) burst out in a cackle.'
 - b. Cuando escupió despiadadamente hacia el suelo, lanzó una carcajada.
'When (pro) spit despicably towards the ground, (pro) burst out in a cackle.'
 - c. Cuando él escupió despiadadamente hacia el suelo, lanzó una carcajada.
'When he spit despicably towards the ground, (pro) burst out in a cackle.'

As exemplified by (12) and (13), PRO sentences included an equal number of instances of verbs in gerundive

and infinitival form¹⁷. This split corresponded to a split, in the finite conditions, between the imperfect and preterite¹⁸ forms of the relevant verbs. The preterite, like the infinitive in Spanish, selects a particular point in time in which an event takes place. The imperfect and gerund forms fail to select any particular point in time and allow for an ongoing event or state. The gerundive

¹⁷ It is also worth noting that in the similar English experiments discussed in Chapter 3 there exists a temporary ambiguity in the sentences; the gerunds could be either preposed adverbials or nominal gerunds. (In fact, one-sixth of the materials used by Fodor, Garrett and Swinney (1994) were grammatically resolved as nominal gerunds, the remainder as preposed adverbials.) This ambiguity does not exist in Spanish, where gerunds can not be used as nominals, as seen in (i):

- i. *Fumando es prohibido.
'Smoking is prohibited.'

Infinitives, when used as nominals, appear either bare or with a definite article, as in (ii). In a subordinate adverbial clause the Spanish infinitive is always headed by a temporal preposition such as *antes de* (before), *al* (upon), or *después de* (after); in this case they can not be resolved as nominals, as seen in iii:

- ii. (El) fumar es prohibido
(the) to.smoke is prohibited
- iii. *Al fumar es prohibido
at to.smoke is prohibited

The gerund can appear preceded by just one preposition, *en* (in/on), but even this is practically unknown in spoken Spanish and rare in written Spanish (Alcina and Blecua, 1975); normally it appears bare, as shown in (iv) and (v):

- iv. Llegando Rita, Juan se fue.
arriving Rita, Juan left
'Upon Rita arriving, John left'
- v. *Mientras llegando Rita, Juan se fue.
'While arriving Rita, Juan left'

¹⁸ Elias-Cintrón et al (1995), in a visual probe task experiment, found no difference between response times to a preterite and an imperfect verb form. In their experiment the former was always the verb *ser* ('to be,' stative sense) and the verb *estar* ('to be,' temporary property).

does not express its own time, but receives it by extension from the matrix verb. It can occur before or during, but never after the action of the matrix verb (Alcina and Blecua, 1988).

The intention in materials design was that S2's subordinate verb should create a strong plausibility bias towards one or the other of the discourse referents as the subject's antecedent. In order to ensure that the bias was strong enough to select one antecedent, normative data were collected in a pre-test using a conscious judgment task. Ninety high school seniors in Madrid (who did not participate in the experiment) were presented with printed questionnaires. For each item, S1 appeared as it does in (10) and (11), and S2 appeared as one of the three fragments given in (12) and (13); one group of participants saw only gerund versions and another group saw only infinitive versions. Two of these fragments matched the spoken stimuli up to the target probe position with the following correspondence: (a) is the PRO condition, and (b) is the *pro* condition. The third fragment type, (c), checked for the impact of sentence content at least 10 syllables beyond the test point.¹⁹

¹⁹ Fragment (c) was included in this pretest in anticipation of Experiment 2.

- (14)
- a. Al ESCUPIR ...
'Upon spitting[inf] ...'
 - b. Cuando ESCUPIO ..
'When (pro) spit ...'
 - c. Al ESCUPIR despiadadamente hacia el suelo...
'Upon spitting[inf] despicably towards the ground...'

- (15)
- a. MENDIGANDO ...
'PRO Begging ...'
 - b. Mientras MENDIGABA ...
'While (pro) was begging ...'
 - c. MENDIGANDO lástimeramente una comida ...
'PRO Begging sorrowfully (for) a meal ...'

Participants were instructed to indicate who was the subject of the verb by writing in either the masculine or feminine subject pronoun, *él* or *ella*, as appropriate. They were also given the option of choosing *ambos* ('both'), *otro* ('someone else'), or *no sé* ('I don't know'). Any materials that incurred more than 10% total incorrect responses in this pre-test were rejected, where 'incorrect' included anything other than the pronoun which was intended, in the materials construction, as indicating selection of the pragmatically congruent antecedent.

For each of the basic discourses, four corresponding probe words were selected, two identity probes and two control probes. Each of the nouns which together had formed the conjoined subject of S1 was used (bare, i.e. without article or adjective) as an identity probe. Given the context established by S1 (together with S2's initial fragment), one of these (e.g. *huérfano*, in example (10) above) matched the discourse-plausible antecedent of the implicit subject of S2's embedded verb (e.g., *PRO mendigando, pro mendigaba*) and was also gender-appropriate in the case of the overt pronoun (e.g. *él mendigaba*). The other, (e.g. *millonaria*) was discourse-implausible and gender-inappropriate.

A neutral control word was selected to correspond to each identity probe; these were inanimate nouns which had not appeared in the prior discourse and were not semantically related to any element of the context. Control probes were matched with their identity probe counterparts in grammatical gender, in number of orthographic characters²⁰ and (to the greatest extent possible) had onset phonemes of the same broad phonological class (e.g. *huérfano/orificio; millonaria/medicación*);

²⁰ Note that in Spanish, *ll* counts as one letter, so that *millonaria* has 9 letters, but 10 orthographic characters, taking up the same physical space on the monitor as *medicación* (when appearing in Courier, a nonproportional font).

frequency of occurrence was not matched (see Section 4.3.1.1 above).

The four classes of probe words represent a factorial combination of Antecedent Type (plausible/implausible) and Probe Type (identity/control). These, in further factorial combination with Pronominal Type (defined by the initial fragment of S2, PRO/pro/overt pronoun), define 12 experimental conditions, and the 48 basic discourses were therefore split into 12 sub-lists, each of four discourses. Twelve versions of the experiment were created to rotate materials sublists over conditions.

Experimental items were interspersed among 54 filler items of similar length and style. For filler items, probe words were randomly chosen nouns; some, but not all of them, were identity probes, in that they were words that had already appeared in the filler. Two examples of the fillers used are given in (16):

(16)

- a. La joven actriz explicó al entrevistador que su vida no es sólo su carrera profesional. Quisiera encontrar al hombre de sus sueños, que aceptara compartir su medio artístico.

'The young actress explained to the interviewer(masc) that her/his life is not solely her professional career. pro would like to meet the man of her/his dreams, who would accept sharing her/his artistic lifestyle.'

TARGET: abogado

- b. Un policía y un rebelde murieron ayer en Colombia durante un ataque guerrillero. Murieron cuando los insurgentes atacaron a una patrulla en el sur del país.

'A policeman(masc) and a rebel(masc) died yesterday in Colombia during a guerrilla attack. pro Died when the insurgents attacked a patrol in the south of the country.'

TARGET: sinceridad

Appendix B lists experimental and filler materials in full.

4.3.4 Procedure

The three versions of S2 were counterbalanced across three tape-recorded scripts so that each tape contained one version of each of the discourse materials and 16 tokens each of the three (PRO/pro/overt) variations of S2. The experimental items, intermingled with the fillers, appeared in a fixed order across the tapes. The pseudorandom ordering was created such that there was never more than two experimental items consecutively. Independent recordings of each of the three scripts were made by an

adult male native Spanish speaker, at a normal speech rate. Cueing tones of 1000-HZ were inserted with a diapirot at the syllable peak following the initial verb of S2. To illustrate, example (12) is repeated here as (17), (26), with the symbol * indicating the position of the tone:

(17)

- a. Mendigando ^{*}lastimeramente una comida caliente, se desmayó.
- b. Mientras mendigaba ^{*}lastimeramente una comida caliente, se desmayó.
- c. Mientras él mendigaba ^{*}lastimeramente una comida caliente, se desmayó.

These tones, inaudible to the participant, controlled the presentation of the visual probes (exposed for 300 ms) and the start of the timer used for measuring the subject's response latencies. Timing signals for filler items were inserted at random positions, but always after the first five and before the last five syllables of the sentence.

Four word lists were created, such that each subject read all four classes of probe words, but read only one of each for any given discourse. The probe words for filler items were consistent across all word lists.

The within-subjects factors, spoken S2 Pronominal Type (PRO/*pro*/overt pronoun), written Antecedent Type (plausible/improbable), and written Probe Type (identity/control) yielded a 3 x (2 x 2) design. Twelve

subject groups, each with five participants, were thus formed.

Participants were seated before a video display terminal which they monitored while listening to a recording through a headset. They heard instructions, prerecorded by the same native Spanish-speaker who read the experimental stimuli. The recording explained that their main task would be to listen attentively to a series of (unrelated) paragraphs. Simultaneously, they were to watch the monitor in front of them. At some point during each paragraph, a word would flash briefly in the center of the screen; they were to say the word aloud as quickly as they could, while continuing to listen to the paragraph. After five practice items, the experiment ran for approximately 30 minutes, with a five-minute break midway. The interval between visual presentation of the probe word and onset of naming was measured in milliseconds and recorded by a computer program. Participants with greater than 10% (>5) missing responses for experimental items were replaced.

Data Treatment. As noted above in Section 4.3.1.1, latencies for target words in an independently conducted naming task were used to control for effects of relative familiarity, as an alternative to printed frequency. Twenty participants read each word aloud as it was presented in isolation on a video monitor, in a

random-ordered list format. Naming times were measured in milliseconds; for each probe word a mean baseline reaction time was calculated, that is, the naming latency for each of the (4x48=192) critical items in isolation. An adjustment constant was then constructed for each item, namely its deviation from the grand mean for all 192 items: 506 ms. So for example, *millonaria*, because of its item-intrinsic traits (frequency, length, acoustic and orthographic features, possibly age of acquisition, and so on) has an average naming latency in isolation of 512 ms, and thus a deviation score of (512-506=) 6. Accordingly, before analyzing the data collected in the main experiment, a constant of 6 was subtracted from each raw reaction time for *millonaria*, and similarly for each of the target words. The corrected reaction time is what I shall call a BART, a baseline-adjusted reaction time. A BART represents the naming latency for each word in the cross-modal task after the filtering out of all non-experimental factors that might influence naming time. The analyses reported below were performed directly on BARTS.

The data reported here are from 60 participants, evenly divided amongst the twelve subject groups. Prior to analysis, any data points that were either missing or greater than 2,000 ms were excluded from the analysis. To limit the distorting influence of outliers, cutoffs were established for each subject (mean plus or minus 2 standard

deviations); any remaining extreme responses were replaced by that cutoff value.

4.3.5 Results and Discussion

The initial analyses of variance were performed separately for each Pronominal Type, with Antecedent Type (plausible/implausible) and Probe Type (identity/control) as within subject/item factors. Then analyses were each carried out in two ways, treating either subjects (F1) or items (F2) as the sampling unit. Summary data are shown in Table 1.

TABLE 1

Mean (baseline-adjusted) naming latencies (ms) as a function of antecedent and probe type, for three pronominal types

	Control	Identity	Difference
PRO			
Plausible	663	628	35
Implausible	675	640	35
<i>pro</i>			
Plausible	688	632	56
Implausible	659	645	14
Overt Pronoun			
Plausible	684	638	46
Implausible	653	636	17

Inspection of Table 1 reveals important differences in the pattern of data outcomes within each of the pronominal types whose contrast is central to the experimental design. These data patterns arise in the estimated magnitude of an 'identity priming effect' -- a performance advantage for identity probes relative to their form-related controls -- which is itself of no special interest, since identity probes had been heard before in S1 while control probes were entirely new in the context. The modulation of that basic effect by the probe's plausibility as an antecedent for the subject of S2's embedded verb constitutes the data

outcome through which experimental hypotheses are to be assessed. These appear to differ strikingly.

In particular, different conditions of plausibility appear to have had no impact at all, for PRO constructions. The estimated magnitude of identity priming has remained unchanged (at 35 ms) for both plausible and implausible probes. For *pro*, in contrast, the identity priming effect seems to have been both enhanced (to 56 ms) and reduced (to 14 ms), for plausible and implausible conditions, respectively. Moreover, this pattern for *pro* constructions is parallel to the pattern for overt pronoun constructions, although for the latter, enhancement and reduction of the basic identity priming effect (to 46 ms and 17 ms, respectively) seems if anything to be less pronounced. In summary, the data patterns shown in Table 1 appear to be consistent with the claim that constructions with PRO and *pro* are handled in quite different ways by the language processor, with only the *pro* case (but not PRO) providing evidence of an antecedent activation bias.

The impressions set out above are by and large confirmed by the statistical analysis. Basic identity priming, as shown in the main effect of probe type (contrasting naming times for identity and control probes), was found to be consistently reliable in the analyses carried out within each pronominal type; for PRO, $F(1,48)=18.38, p<.001$, $F(1,36)=29.11, p<.001$; for *pro*,

$F_1(1,48)=22.89$, $p<.001$, $F_2(1,36)=13.10$, $p<.001$; and for overt pronoun, $F_1(1,48)=14.98$, $p<.001$, $F_2(1,36)=11.94$, $p<.01$.

The influence of the plausibility contrast on basic identity priming is revealed, in the analyses, in the interaction of Antecedent Type and Probe Type. Here, the analysis for PRO showed no evidence of interaction, $F<1$ in both subject and item analyses. For *pro*, the same term revealed a reliable interaction, $F_1(1,48)=8.89$, $p<.005$, $F_2(1,36)=5.00$, $p<.05$. Finally, for overt pronoun, the interaction was reliable only in the subject-based analysis, $F_1(1,48)=4.06$, $p<.05$, $F_2(1,36)=2.35$, $p>.10$.

For a critical test of the claim that the processor handles constructions with PRO differently from constructions with *pro*, analyses across pronominal types are required. Of interest here is the *higher-order* interaction term, Pronominal Type by Antecedent Type by Probe Type. This term reflects the sameness or difference, across pronominal types, of the outcome pattern revealed by the antecedent-by-probe type interaction seen (or not) in the analysis conducted separately within each pronominal type.

The analysis across PRO and *pro* showed that the pattern of unchanged identity priming of the former (35/35 ms) was significantly different from the enhanced and reduced pattern of the latter (56/14 ms); for the higher

order interaction of pronominal type by antecedent type by probe type, $F_1(1,48)=4.90$, $p<.05$, $F_2(1,36)=5.36$, $p<.05$. The analysis therefore provides direct evidence that available non-linguistic clues are exploited by the processor in different ways for PRO and *pro* constructions; issues of antecedent plausibility appear entirely irrelevant in the case of PRO, but can be used to select a preferred antecedent in the case of *pro*.

In contrast to the finding of a reliable difference in outcome patterns for PRO and *pro*, the same kind of analysis across *pro* and overt pronoun revealed no higher order interaction, $F<1$ in both subject and item analyses. There are, therefore, no grounds in this combined analysis for claiming that the 56/14 pattern of the former differed from the 46/17 pattern of the latter.

In the initial analyses reported above, the basic interaction of antecedent plausibility and probe type which signals a bias in antecedent activation was fully reliable only for *pro*, but failed to reach significance in the item-based analysis for overt pronoun. It is of interest, therefore, that in this more powerful analysis combining these two pronominal types, the basic interaction was shown to be significant, $F_1(1,48)=12.42$, $p<.001$, $F_2(1,36)=7.17$, $p<.01$. The higher order interaction, crucially, was absent.

In sum, although plausibility was the only available source of disambiguation in the *pro* construction, there is really clear evidence of bias in antecedent activation, certainly no **less** effective than the bias which arises out of the gender disambiguation in the case of the overt pronoun. But for PRO there was no such bias in antecedent activation, and the statistical analysis provides direct evidence of the contrast between PRO and *pro*.

This differential treatment of two phonetically-null pronominals suggests a mental architecture in which the processor recognizes and honors the difference in grammatical status between the null subject of a finite verb, *pro*, and that of a nonfinite verb, PRO. For the former, which is syntactically free, the processor rapidly accesses its antecedent in the discourse and employs the available pragmatic clues to that end. But for the latter, syntactically linked to a controller which, in the experimental sentences, is yet to be encountered, the pragmatic clues available in the discourse are **not** employed in the search for the antecedent -- at least temporarily. This is what should be expected of a modular language processor.

Experiment 1, the main experiment of this dissertation, has established quite clearly that the processor handles PRO and *pro* constructions very differently, at least in an assessment of antecedent

activation at a point in the word string which is very close to the site of a null subject. As a follow-up, Experiment 2, reported below, extends the observational base by testing at a point further downstream. Finally, Experiment 3 undertakes a follow-up investigation of what appears to be a curious feature of the data of Experiment 1.

For the logic behind Experiment 1, and the argument about mental architecture supported by its findings, different patterns of antecedent activation bias for different pronominal types represent the crucial finding. Exactly how those patterns arise is itself not critical. Yet close inspection of the data summarized in Table 1 suggests, somewhat surprisingly, that the interaction pattern in the *pro* and overt pronoun conditions (and the absence of interaction in the PRO condition) might arise more because of an inhibition acting differentially on form-related control probes than because of facilitation acting differentially on identity probes.

This impression was given support by post-hoc analyses, across all three pronominal types, examining control probe data and identity probe data separately. Only in the data for control probes was there an interaction of Pronominal Type and Antecedent Type, $F_1(2,96)=4.35$, $p<.025$, $F_2(2,72)=4.95$, $p<.025$. That interaction apparently arises because of slowed responses

to plausible controls relative to implausible controls, holding for *pro* and overt pronoun but not for PRO. In contrast, in the data for identity probes, examined separately, no such interaction was evident, $F_1(2,96)=0.75$, $p>.25$, $F_2(2,72)=0.53$, $p>.25$. Experiment 3, therefore, puts to the test a particular hypothesis about the kind of psychological mechanism that might operate in cross-modal identity priming to drive such an inhibition in control probes which are merely form-related to potential antecedents.

4.4 Experiment 2

The goals of this experiment are two-fold: first, to examine whether the outcome patterns observed in Experiment 1 for *pro* and overt pronouns are observable with delay in the test point for PRO; and second, to determine the extent to which the observed patterns deteriorate with delay for *pro* and overt pronouns.

One of the specific advantages of the cross-modal priming task is that it allows for examination of effects of interest at any chosen point in the input. Past investigations have shown that modest changes in the position of a test probe relative to the ongoing speech stream can lead to highly significant changes in outcome (Swinney, 1979; Ni, Fodor, Crain, Shankweiler and Mattingly, 1993). It may be that the only way to know the

precise time course of antecedent activation is to probe at a great many discrete points. Ni *et al* (1993) have shown that antecedent activation effects come and go at 150 ms intervals for slow-normal speech, and at 80 ms intervals in test point location for 50% compressed speech. Given the logistical difficulty of an approach calling for multiple, closely-spaced test points, when issues of experimental power are to be considered, we chose in Experiment 2 to examine just one additional position 300 ms 'downstream' from the sentence position tested in Experiment 1 (immediately after the first verb of S2).

While it is obvious that the antecedent activation bias effect seen for *pro* and overt pronouns in Experiment 1 would eventually decline with elapsed time, there is no way to be certain precisely how long this might take. The sentence position tested, 300 ms downstream from the test position in Experiment 1, might well be sufficient for the observed interaction to begin to decrease, and perhaps even dissipate entirely.

For the PRO condition, the strongest version of the modularity hypothesis would predict no selective activation for any one antecedent until PRO has been coindexed with its syntactic controller. That coindexing must be with the subject of the matrix clause, and in the experimental sentences that can not occur until further downstream than the 300 ms delayed test point. Moreover, in principle, the

appearance in the stimulus of the controller could be an infinite distance downstream from PRO, at least grammatically, as illustrated by (17):

(18)

PRO Begging miserably a hot meal, cold and wet from prolonged exposure to the terrible winter weather in Madrid, fearful that the restaurant owner would jealously guard the small bit of heat emanating from inside

My own intuition is strong that, given the preceding discourse context, it is neither necessary nor efficient to wait until the matrix clause is reached to interpret potential referents of PRO; indeed, it is highly counterintuitive to expect that the processor would completely ignore consciously available pragmatic clues while awaiting (for an indeterminate period) the appearance of the controller in the following matrix clause.

Accordingly, a weaker prediction is that the processor might take note of the syntactic dependency of PRO but might recognize that the antecedent will not appear until the following clause (and even that only with luck), and therefore possibly select among candidates from the set offered by the discourse, in an attempt to build a complete interpretation as soon as possible.

Most models of the processor assume that rapid interpretation is highly valued. It has been proposed, for example, that the parser operates on a first-available-analysis principle (Rayner, Carlson and Frazier, 1983); parsing strategies like minimal attachment are insensitive

to the possibility that the choices they dictate may eventually be proven incorrect, risking an increase in processing complexity should re-analysis become necessary. Speedy interpretation is also a driving force in the discourse-driven model of Crain and Steedman (1985). According to the 'weak interaction' hypothesis proposed by these authors, there would be rapid filtering of representations produced by the grammar module by the faculties processing general knowledge of discourse and the world. Altmann's (1989) Principle of Referential Failure requires that the processor attempt to establish the intended reference of an NP as soon as it is encountered. Thus the parser may, in a strictly autonomous manner, inform a higher interpretative faculty of everything it knows for the moment, which is that the NP is a controlled one but that the controller has yet to be encountered. The discourse processor may then proceed to entertain its own guesses as to the intended referent, while waiting for the final word from the grammar. Accordingly, it is entirely possible that there will be evidence of activation by potential antecedents for PRO sometime before the position of its syntactic controller.

4.4.1 Method

Participants. Participants were 75 volunteers recruited from the same subject pool as had been used in Experiment

1. None had participated in the earlier experiment, nor in any of Experiment 1's materials-rating or other pre-tests.

Materials and Design. For this experiment the recorded tapes and word lists were exactly those used in Experiment 1.

4.4.2 Procedure

All procedures were identical to those in Experiment 1, except that a computer-timed delay of 300 ms was imposed between the audio tape's post-verbal cueing tone and the visual presentation of the word that was the target for a naming response. Thus probe positions fell from two to four syllables downstream of the postverbal position employed in Experiment 1, as illustrated in the examples below. As earlier, test position is indicated by *, and for purposes of comparison, the embedded verb whose offset marked the test point in Experiment 1 is italicized:

(19)

La gitana y el cliente se sentaron delante de la bola de cristal. Mientras *predecía* un futuro próspero y feliz, sintió un leve ardor en las mejillas.

(20)

El ingeniero de sonido y la estrella famosa estaban preparados para la grabación del disco. Mientras cantaba el tema musical del film más popular, causó buena impresión a todos los presentes.

(21)

Después de la comida, el mesonero y la forastera discutieron sobre el precio de la consumición. Una vez resuelto el asunto, *abonando* malhumorada*mente el total de la cuenta, se levantó de la mesa.

4.4.3 Results and Discussion

All conventions of data treatment established in Experiment 1 were followed here, exactly. The initial analyses of variance were performed separately for each Pronominal Type, with Antecedent Type (plausible/implausible) and Probe Type (identity/control) as within subject/item factors. Then analyses were each carried out in two ways, treating either subjects (F1) or items (F2) as the sampling unit. Summary data are shown in Table 2.

TABLE 2

Mean (baseline-adjusted) naming latencies (ms) as a function of antecedent and probe type, for three pronominal types

	Control	Identity	Difference
PRO			
Plausible	670	629	41
Implausible	646	631	15
<i>pro</i>			
Plausible	661	630	31
Implausible	651	632	19
Overt Pronoun			
Plausible	653	634	19
Implausible	646	638	8

Inspection of Table 2 reveals the same performance advantage for identity probes relative to their form-related controls that was seen in Experiment 1, although the general level of that identity priming effect appears to be reduced from before, particularly for the overt pronoun. More crucially, the non-impact of the plausibility factor for PRO seen in Experiment 1 seems, to some degree, to be replaced by a pattern more like that seen for *pro* and overt pronoun in the earlier experiment, although not to quite the same degree. At the same time, different conditions of plausibility appear to have had very little impact on *pro* and overt pronouns this time; the bias in antecedent activation that was seen in Experiment 1 seems to be collapsing. Indeed, a 300 ms difference in test position appears to have changed the overall picture dramatically. In summary, the data patterns shown in Table 2 provide no indication of any antecedent activation bias for either the *pro* or overt pronoun case, while there seems to be a trend toward such a bias in the PRO case.

The impressions set out above are by and large confirmed by the statistical analysis. Basic identity priming, as shown in the main effect of probe type (contrasting naming times for identity and control probes), was again found to be consistently reliable in the analyses carried out within each pronominal type, although for the

overt pronoun it was reliable only in the subject analysis; for PRO, $F_1(1,48)=8.18$, $p<.005$, ($F_2(1,36)=6.85$, $p<.025$); for *pro*, $F_1(1,48)=9.63$, $p<.005$, $F_2(1,36)=8.56$, $p<.01$; and for overt pronoun, $F_1(1,48)=4.81$, $p<.05$, $F_2(1,36)=8.56$, $p>.10$.

Just as in Experiment 1, the influence of the plausibility contrast on basic identity priming is revealed in the interaction of Antecedent Type and Probe Type. Interaction approaches significance in the PRO condition, but not even that trend is seen for *pro* and overt pronoun; for PRO $F_1(1,48)=2.90$, $.05<p<.10$, $F_2(1,36)=3.85$, $.05<p<.10$); for both *pro* and overt pronoun, $F<1$ in subject-based and item-based analyses. No further statistical comparisons were performed.

Experiment 2 has shown that the antecedent activation bias, demonstrated in Experiment for *pro* and overt pronoun, has for all intents and purposes dissipated entirely within 300 ms. There is indication of a trend in the PRO condition towards the interaction pattern seen previously for *pro* and overt pronoun, although it does not reach conventional levels of significance. These changes in outcome affirm the rapid rise and decline of such effects attested to in previous research.

It could be speculated that the 300 ms delay was sufficient for pragmatic influences to begin to emerge in the PRO constructions, coinciding with the decline of those

same influences in the *pro* and overt pronoun constructions. In this sense, just as in Experiment 1 PRO and *pro* could be seen as being handled in different ways by the processor, with treatment for the latter being more in correspondence with that for overt pronouns; it must be acknowledged, however, that Experiment 2's evidence on this point is in no way compelling.

4.4.4 General Discussion

Experiment 1 has produced very clear evidence that the processor's behavior in the context of *pro* is distinctly different from its behavior in the context of PRO. An antecedent activation bias has demonstrated the on-line influence of plausibility in the processing of non-anaphoric pronominals, regardless of their phonological content. But the same pragmatic clues have failed to influence an activation bias in the processing of controlled PRO. This is the kind of outcome pattern that is predicted by the modularity hypothesis.

While the evidence provided by Experiment 2 is inconclusive, it is at least in concord with the distinction seen in Experiment 1. It does leave open the speculation that there may be a late-emerging activation bias effect for PRO; if this speculation were confirmed, it would suggest that there may be some time limit on the priority allotted to the syntactic module. In Section 5.2

I will consider alternative interpretations of the results, in the light of non-GB theoretical accounts of null subjects. Experiment 3, described below, was designed to test the hypothesis that the apparent 'inhibition' of the control probes was due to their form-similarity with the identity probes.

4.5 Experiment 3: Inhibition Mechanisms in Antecedent Activation

While studies of coreferential processing are usually discussed in terms of antecedent (re)activation, it has been noted that a mechanism of inhibition may also be at play. Gernsbacher (1984) reported a series of visual probe recognition experiments in which explicit repeated name anaphors triggered not only an enhancement of their antecedents but also a suppression of other, non-antecedent participants. The suppression effect was also triggered by overt pronouns when they matched the gender of only one participant²¹. Gernsbacher suggests that the intervention of other concepts may be underlying this suppression.

²¹ The suppression mechanism was apparently triggered more quickly by the repeated name than by the pronoun, for which the effect was seen only at the end of the sentence.

In Experiments 1 and 2 there appeared to be no specific inhibition of the implausible antecedent,²² even in the context of an overt pronoun that matched the gender of only the other discourse referent. An examination of Experiment 1's data suggested that the critical interaction of antecedent plausibility and probe type which was observed for the two finite verb phrase constructions (*pro* and overt pronoun) was largely driven by changes in response time for the control probes, rather than for the identity probes. That is, when evidence of activation bias was detected, it seemed to manifest itself more via an inhibition of the form-related control for the plausible antecedent than via a facilitation of the plausible antecedent, itself.

It was suggested in Section 4.3.5 that the inhibitory effects may be attributable to any of the several characteristics of form shared by the identity and form-related control words. These pairs were matched for number of characters, onset phone, and grammatical gender. It seems likely that the mechanism arises in the context of the naming task, rather than as any general suppression of non-antecedents. Once an antecedent has been reaccessed, and a word appears on the screen to prompt a response, it

²² It has been suggested that the lack of an observed facilitation effect for the plausible, gender-matched antecedent may have been due to a ceiling effect. The fact that there was no such effect in the Gernsbacher studies highlights, once again, the sensitivity of experimental results to different methodologies.

is not unlikely that the participant would be prepared to pronounce the name of the antecedent. When the word ultimately turns out to be other than the reaccessed antecedent, some recovery time may well be needed to suppress the pronunciation of the anticipated response before access and pronunciation of the actual target can be initiated.

If it is indeed a side-effect of antecedent reactivation in combination with the naming task that produces inhibition, then there is nothing that would make such inhibition applicable to only Spanish, or, for that matter, to only activation of antecedents for null and overt pronouns. Accordingly, the mechanism should be observable in a cross-modal priming naming task study conducted in English, with English speakers and English materials. Just such a study was run in an attempt to test the hypothesis that inhibition arises because of response competition.

The idea was to proceed with a construction that had in previous CMP experiments demonstrated clear effects of antecedent reactivation. English reflexives in object position made a good choice, since they had been observed to demonstrate antecedent reactivation (Nicol, 1988), their coreferential relations are maximally constrained by syntactic principles, and they are well-suited for the manipulations required by the experimental design. A

sample construction is given in (22), where the reflexive anaphor *himself* selects the *banker* as its only uniquely grammatical antecedent:

(22)

- a. Every Monday morning, the banker from one of the most influential institutions in the city apprises himself of the agenda for the entire week.
- b. Every Monday morning, the banker from one of the most influential institutions in the city apprises the clerks of the agenda for the entire week.

Probe: BANGLE

This study concentrated on the role played by the similarity of form between the binding antecedent (the *banker*, in (22) and the naming probe (*bangle*, in the same item). The probe word was held constant across all conditions, and the control factors were introduced by creating four versions of each sentence. One factor was created by changing the object of the transitive verb, in order to contrast the referentially-dependent reflexive with a neutral and referentially-free NP expression. To illustrate, in (22), the example sentences above, *himself* was interchanged with *the clerks*. A second control factor compared similarity of the antecedent to the probe. This was done by interchanging the potential antecedent with another NP which does not share any of the selected form characteristics with the probe word. In (23), this was effected by interchanging *banker* with *treasurer*, which shares none of the selected form similarities with *bangle*.

The probes always appeared immediately after the direct object of the main verb.

(23)

- a. Every Monday morning, the treasurer from one of the most influential institutions in the city apprises himself * of the agenda for the entire week.
- b. Every Monday morning, the treasurer from one of the most influential institutions in the city apprises the clerks * of the agenda for the entire week.

Probe: BANGLE

According to the form-driven inhibition hypothesis, it is expected that naming latencies for the same probe word should be longer when it was similar to the antecedent, but only in the reflexive condition which triggers antecedent reactivation, and not in the condition with an explicit lexical NP as the direct object.

4.5.1 Experiment 3

4.5.1.1 Method

Participants. Fifty undergraduate students at Rutgers University participated in this experiment for extra credit in a psychology course. All were native speakers of English with normal or corrected vision. Data for participants with more than 10% erroneous or missing responses were discarded, the sample being reduced to 40 participants evenly divided into four groups.

Materials and Design. Thirty-two experimental quadruples were constructed, a quadruple being four versions of one basic sentence. For each of these, there was one probe word selected for the naming target word. In each sentence a common noun identifying a human by occupation (*hairdresser, carpenter*), activity (*tourist, swimmer*) or recognizable feature (*adolescent, orphan*) was the subject of a transitive verb.

In two versions within each set, the object of the verb was a reflexive; in half the items this was *himself* and in the other half, *herself*. These two reflexive versions differed from each other in that their subjects were different lexical NPs, either of which was an equally plausible subject of the sentence, (*hairdresser/stylist, secretary/assistant, banker/treasurer.*)

Critically, these subject nouns differed in their form relation to a naming target which remained fixed for all versions of a quadruple. To provide the strongest possible test, the criteria selected to establish form similarity were more precise and consistent than those which had been used in the materials of Experiment 1: one, the subject of version (a), shared several orthographic and phonological characteristics with the naming target, another noun unrelated in meaning; the other, subject of version (b), did not share any of these features. The shared properties were: number of letters, initial letter, initial phoneme,

number of syllables, and stress pattern. Additionally, form-similar subject nouns had at least one vowel in common with the naming target. To parallel the critical cases of Experiment 1, naming targets were always inanimate nouns, unassociated or otherwise related in meaning to the subject of the sentence. In the example (24) given below, the naming target used was *silence*, form-similar to the subject noun *stylist* but not to the alternative subject noun *hairdresser*.

(24)

a. At the uptown beauty salon, the stylist at the last work station near the back of the shop admired herself * in the mirror in front of the chair.

b. At the uptown beauty salon, the hairdresser at the last work station near the back of the shop admired herself * in the mirror in front of the chair.

Target: silence

In the other two versions within each quadruple, the object of the verb was another unrelated common noun, which was selected to be as pragmatically as plausible in that role as was the reflexive object, by the judgment of the experimenter:

(25)

- a. At the uptown beauty salon, the stylist at the last work station near the back of the shop admired the girl * in the mirror in front of the chair.
- b. At the uptown beauty salon, the hairstylist at the last work station near the back of the shop admired the girl * in the mirror in front of the chair.

Target: silence

Thirty-four filler sentences were also prepared; five of these were used as practice items and the remainder were interspersed with the experimental items in a pseudo-random order. They were all single sentences with transitive verbs in the matrix clause, several with plural antecedents and several with pronouns as objects. Examples are given in (26):

(26)

- a. As soon as the customer entered the boutique, the shopkeeper greeted her * and offered to help with her selections.

Target: customer

- b. Training at the gym four hours a day, the Olympic gymnast and the Eastern European trainer impressed everyone * with their dedication and focus.

Target: dictionary

Half of the naming targets for the filler sentences were words that had appeared in the corresponding sentence, as in (26)a, and the other half were new words, as in (26)b. The distribution of the probes on filler items was

manipulated so as to replicate the pattern of identity/form-related/unrelated targets that existed in Experiments 1 and 2, in case that situation had in some unspecified fashion contributed to the original inhibition effect. A complete set of materials appears as Appendix C.

The four sentence versions represent a factorial combination of Object NP Type (reflexive versus neutral) and Probe Similarity (similar versus dissimilar). These define four experimental conditions, and four scripts were prepared, so that each recording included one version of every quadruple and 8 tokens of each of the experimental conditions. Items appeared in the same pseudorandom order on all four tapes, intermingled with the fillers which did not vary. Four independent recordings were made of an adult female native speaker of American English, at a normal rate of speech.

Cueing tones, which were inserted and which functioned just as in Experiments 1 and 2, were positioned at the offset of the direct object NP, as illustrated by examples (24) to (25) above. The diacritic * marks target positions.

The within subjects factors, Object NP Type (reflexive/neutral) and Probe Similarity (similar/dissimilar) yielded a 2 x 2 design, with four subject groups.

4.5.1.2 Procedure

Participants read printed instructions which explained the task, identical to the task in Experiments 1 and 2. They were seated before a video display terminal which they monitored while listening to a recording through a headset. After five practice items, the experiment ran for approximately 20 minutes. The interval between visual presentation of the probe word and onset of naming was measured and recorded by a computer program. Participants with more than 10% missing responses to the experimental items were rejected from further analysis.

4.5.1.3 Results and Discussion

Analyses of variance were carried out in two ways, treating either subjects (F1) or items (F2) as the sampling unit. Summary data are shown in Table 3.

TABLE 3

Mean naming latencies (ms) as a function of direct object and antecedent type

	<u>Object NP Type</u>	
	REFLEXIVE	NEUTRAL
<u>Probe Similarity</u>		
SIMILAR	644	632
DISSIMILAR	649	635

Absolutely no effects of Probe Similarity, nor any interaction of similarity with Object NP Type, were found, $F < 1$ in all cases. This lack of a similarity effect, and especially the lack of interaction with object NP type, taken with the reasonable assumption (based on previous literature) that antecedent reactivation occurs at the reflexive anaphor, implies that reactivation does not have any influence on the naming latencies of non-antecedent probes by virtue of their form similarity or dissimilarity to the antecedent. The experiment conclusively fails to find evidence of a source of any inhibitory effect in the form properties of control probes.

Analyses of variance performed over subject and item data showed one marginally significant effect, that of Object Type $F(1,36)=3.99$, $.05 < p < .10$; $F(1,28)=5.20$, $p < .05$. This main effect arises because of an advantage in reaction time for the neutral condition (634 ms, on average) over that for the reflexive (647 ms, on average). This effect is not strictly relevant to the purpose for which the experiment was designed, but it is nonetheless interesting. The advantage for the neutral condition might be attributable to an extra processing load imposed by the resolution of the anaphora, which suggests that the antecedent was indeed reactivated by the reflexive.²³

²³ In fact, we might have expected the contrary, i.e., a disadvantage in reaction time
(continued...)

In sum, there was a complete failure in Experiment 3 to produce evidence of an inhibition effect which has its source in the form properties of words. One possible interpretation of such a null result would be that our hypothesis about the outcome patterns from Experiment 1 was mistaken, and that they can not be explained in terms of inhibition through antecedent reactivation. It might be said, for example, that the shared characteristics chosen for matching Experiment 3's naming targets with the antecedents of the reflexive were not sufficient to produce the desired effects. Those features referred mainly to the global characteristics of the word form rather than to specific segmental content; perhaps a wider overlap in the form of each word pair would have been required. Recall, however, that the criteria applied in Experiment 3 were even stricter than those in Experiments 1 and 2, and the

²³(...continued)

of the neutral condition, due to an unplanned complication in the materials that was not recognized until after the experiment had already been run. A structural ambiguity was inadvertently introduced into about 60% of the neutral sentences. For example, in "the hairdresser at the uptown beauty salon admired the girl in the mirror...", the PP "in the mirror" could be attached to the NP "the girl" or to the verb "admired". This ambiguity did not occur in the reflexives; "herself in the mirror" cannot be a constituent, since the reflexive anaphor cannot be bound from outside the NP (its local domain). Nevertheless, it does not seem likely that this ambiguity had a significant effect on the experimental sentences, since the ambiguity does not arise until after the probe position. There is still some possibility that it affected the naming times of the probes, since the next word was the (usually monosyllabic) preposition that introduced the ambiguity.

constructions exploited here represent a more constrained case for antecedent reactivation.

Two plausible accounts present themselves, both of which make reference to differences between English and Spanish. The first, which will not be pursued further in this dissertation, is specific to use of the naming task. Performance of the task is assumed to involve access of each target from the mental lexicon; this is supported by the finding (Forster and Chambers, 1973) that words are named faster than nonwords, along with the sensitivity of the task to printed word frequency. But while the correct pronunciation of English words is notoriously difficult to predict based on spelling alone, Spanish pronunciation is almost entirely predictable from the spelling. It remains possible, then, that the naming task invokes different mechanisms in Spanish than in English.

Another more interesting proposal focusses on a kind of form similarity that existed in addition to the phonological (and/or orthographic) similarity that was the focus of Experiment 3 -- since that experiment has shown the latter **not** to have been the primary source responsible for the reaction time differences observed in Experiments 1 and 2. In addition to the phonological similarity, another feature that identity and control probes always had in common was their grammatical gender. Furthermore, it was grammatical gender, consistently determined for the

antecedent NP and overtly marked by the definite article, that systematically distinguished between potential antecedents in the S1 sentences. So it is certainly possible that when the plausible antecedent was reactivated, then another similar word with the same gender was inhibited. If agreement were indeed so crucial, that would explain the failure to obtain the inhibitory effect in English, where grammatical gender for nouns is virtually nonexistent. This possibility will be discussed further in Chapter 5.

CHAPTER 5

CONCLUSION AND FURTHER ISSUES

5.1 Introduction

This chapter will begin in Section 5.1.1 with a review of the findings of Experiments 1 and 2. In Section 5.2 alternative interpretations of the results, in the light of non-GB theoretical accounts of null subjects, will be considered. In Section 5.3 several possible refinements of the experiments will be proposed, and in Section 5.4 an alternative construction with which to compare the processing of *pro* and PRO will be introduced. Section 5.5 will address some issues which are raised, with respect to more recent developments in syntactic theory, about the role of agreement in licensing subjects. One avenue of research suggested by these developments warrants a consideration of whether the processing data could be accounted for without appeal to ECs, by reference to other phenomena such as Spec-head relations. A proposal will be made, emphasizing the role of agreement in on-line processing as well as the notion of markedness of feature values, and suggesting that only marked values are present in the linguistic representations employed by the processor.

5.1.1 Review of Experimental Findings

Experiments 1 and 2 (see Chapter 4 for full detail) contrasted the effects of pragmatic plausibility clues on the coreference processing of three different kinds of pronominal subjects. Two of them (*pro* and PRO) are phonologically null, in contrast with the third, lexically expressed overt pronouns. In terms of obligations to the syntax, however, the split goes another way: two of them (overt pronouns and *pro*), because they are pure pronouns, are argument-free within the local domain, meaning that they are free to select an antecedent from within the discourse. These contrast with PRO, a pronominal anaphor. PRO must be coindexed with its antecedent which, in the experimental sentences, did not appear until **after** the test point. Thus, any effect of plausibility clues on the processing of PRO at the test point would be evidence of interaction in a manner prohibited by the modularity of language hypothesis, in the sense in which it is understood here (see Section 1.4).

In both the overt pronoun and *pro* conditions, a differential effect was found between a contextually plausible antecedent (relative to its control) and a contextually implausible antecedent (relative to its control). This interaction was interpreted to be evidence of the immediate influence of plausibility on coreference processing of pure (i.e. [-anaphor]) pronouns, regardless

of their phonological status. In contrast with the pronoun conditions, there was no indication of the same immediate influence in the processing of PRO, the only pronominal which, at the linear positions tested, had an as yet unfulfilled syntactic commitment.

This contrast between the processor's treatment of *pro* and overt pronouns, on the one hand, and that of PRO, on the other, is indicative of a modular language processor. It can not be argued that the plausibility clues were not yet available to the perceiver, given their observed influence in the first case. The lack of such influence in the second case, therefore, must be due to the priority allotted to syntax in the processing of an NP whose antecedent is syntactically determined.

5.2 Psycholinguistic Existence Proofs of ECs

While the linguistic differences between free versus constrained pronominals are undisputed, the proper syntactic representation of these facts is not. An exposition of alternative representations is outside the scope of this dissertation, but it is important to acknowledge their existence and how they might be implicated in the interpretation of the experimental evidence for processing of ECs.

It has been argued (Sag and Fodor, 1995) that most of the motivation for positing the existence of ECs has been

theory-internal to GB. In contrast with GB, which posits four ECs, there are no empty NPs posited by Lexical Functional Grammar in its current form (Kaplan and Zaenen, 1988), or by most categorial grammars (e.g. Ades and Steedman, 1982; Steedman, 1987). Head-Driven Phrase Structure Grammar (HPSG) (Pollard and Sag, 1994) does posit one EC, *wh*-trace, but the final chapter of that book proposes the possibility of a traceless analysis of *wh*-movement; this proposal is further explored by Sag and Fodor, 1995. Each of these theories imposes the relevant constraints on the association between the gap and the antecedent, none of them does so by means of empty categories. Fodor (1991, 1993) has argued that psycholinguistic investigation can assist linguists in choosing between alternative theories. An extensive body of research has been inspired by the transparency hypothesis, which assumes that the structural representations used by the on-line processor reflect the structural representations defined by the grammar. One aim of this research has been to find psycholinguistic proofs for or against the existence of ECs. Evidence of on-line antecedent activation for a particular EC has been interpreted as **external** evidence for that EC.

Because this research has been done almost entirely in English, there has been virtually no mention of *pro*. There have been some studies on PRO (see discussion below), and

on *wh*-trace and NP-trace, the two kinds of traces posited by GB theory to be created at S-structure by operation of the syntactic rule *move α* . By *move α* , an NP can move from its D-structure position to either another argument (A) position or to a non-argument (A') position. In the first case, which arises in, e.g., passive constructions, the moved NP binds and is coindexed with an NP-trace in the original position. In the second case, as in, e.g., the formation of *wh*-questions, the moved NP is coindexed with and binds a *wh*-trace, holding the original position. Via this chain the antecedent inherits a θ -role. (The two kinds of chain differ in certain other respects, important to linguistic theory, but not of relevance to current concerns.)

However, existing results from studies examining antecedent reactivation by ECs do not present a clear body of evidence regarding the correct inventory of ECs. The following section will briefly summarize the EC antecedent activation findings¹ from two different tasks: the first is a visual probe recognition task, and the other is the cross-modal priming (CMP) task (discussed in detail in Chapters 3 and 4).

¹ The focus here will be on studies of null pronominals, namely PRO (since *pro* has not previously been investigated). For review of the broader program of research, see Fodor (1989, 1993); Nicol and Swinney (1989).

5.2.1 Combined Evidence from Two Paradigms

The visual probe recognition task² requires participants to decide whether or not a probe word appeared in the visually-presented material that preceded. One series of experiments within this paradigm used the visual probe recognition task to look for antecedent reactivation by three different ECs: PRO, NP-trace, and wh-trace³ (Bever and McElree (1988) and McElree and Bever (1989)). Sentences were matched in (more or less) parallel constructions. The probe word was an adjective that modified the appropriate antecedent for each EC. The measure of facilitation was the response latency in the anaphoric condition compared with the response latency in the control construction, which contained no anaphoric NP. An example is given in (1):

² This task has also been referred to as visual probe verification (Gernsbacher, 1989). It was which was originally developed as a priming technique for overt anaphoric elements in studies of multisentence discourses (McKoon and Ratcliff, 1980; Dell, McKoon and Ratcliff, 1983).

³ The evidence for wh-trace is actually from a 'tough' construction that was considered an NP-trace by the experimenters. This trace has been argued to be wh-trace (Chomsky, 1977), but its status has been the source of considerable linguistic uncertainty.

(1)

Non-Anaphoric Control:

- a. The astute lawyer who faced the female judge hated the long speech during the trial.

Overt Pronoun:

- b. The astute lawyer who faced the female judge hoped he would speak during the trial.

PRO:

- c. The astute lawyer who faced the female judge strongly hoped PRO to argue during the trial.

NP-trace:

- d. The astute lawyer who faced the female judge was certain [e] to argue during the trial.

'Tough' (wh-trace) Construction:

- e. The astute lawyer was hard for the judge to control [e] during the very long trial.

Recognition Probe: astute

No indication of facilitation was observed at the first probe position (which was immediately following the gap) for any EC, but at the end-of-sentence test point there was evidence of facilitation for all three EC constructions, relative to the gapless control construction, (1)a.

It was noted that the observed effect for PRO was significantly less than for either of the trace constructions (d) and (e). A second experiment was designed to directly compare PRO with NP-trace; a sample item set is given in (2):

- (2)
- a. The conceited actor/ who worked with the leading lady/ was eager PRO to * rehearse for the entire evening.*
 - b. The conceited actor/ who worked with the leading lady/ was sure [t] to */ rehearse for the entire evening.*
 - c. The conceited actor/ who worked with the leading lady/ was rude to */the rehearsers in the evening.*

Recognition probe: conceited

In this experiment, facilitation was observed in the NP-trace condition (2)b, as compared to the gapless control condition, (2)c. This time, however, there was no significant difference at all between the PRO condition (2)a and the control condition, thus reinforcing the conclusion that the processor was not as sensitive to the presence of PRO as to NP-trace.

McElree and Bever proposed that this difference in activity level is due to a difference in the status of the two elements in the θ -grid. NP-traces, they reasoned, are salient because they "provide the first opportunity to incorporate the antecedent into an argument structure." The antecedent of PRO, on the other hand, has its own θ -role. Thus, unlike NP-trace, there is no other element whose θ -role assignment hinges on the identification of PRO, so there is no pressure from the antecedent for its coindexation with the EC. This line of reasoning implies that θ -role assignment, as opposed to EC antecedent

activation, is the primary catalyst for the observed effects. A movement trace initiated the thematic interpretation of the antecedent, and this is why, it is proposed, its presence causes an increase in activation of the antecedent. One problem with this account is that it fails to explain the activation of the overt pronoun in Experiment 1 of the same study, since in that case the activation cannot be attributed to the sharing of a θ -role by two elements.

Further visual probe recognition evidence for NP-trace is provided by experiments (MacDonald, 1989; Elías-Cintrón, Kurtzman and Montalbetti, 1995) which compared processing of syntactic passives with processing of adjectival 'passive' constructions. GB posits an NP-trace in the former construction, but not the latter. Differential recognition latencies for the head noun of the antecedent of the syntactic passive and for the same noun in the context of the adjectival passive construction were interpreted to indicate facilitation of the NP-trace where it is posited.

The combined results of the probe recognition studies, then, show antecedent activation effects for *wh*-trace, NP-trace and possibly PRO, though PRO has given the weakest effect. On the other hand, cross-modal priming experiments have shown reactivation for the antecedent of *wh*-trace comparable to that of overt pronouns and anaphors (Swinney,

Ford, Frauenfelder and Bresnan, 1988), but priming for NP-trace (Fodor, McKinnon and Swinney, reported in Fodor, 1983) and PRO (Nicol, 1988) has been slow, inaccurate, or both.

5.2.2 The Linguistic Levels Hypothesis

Fodor (1989, 1993) has attempted to clarify these data by dividing them into distinct groups, depending on the experimental technique by which they were obtained. The linguistic levels hypothesis proposes to explain the conflicting patterns of results by attributing to the two experimental paradigms different patterns of access to linguistic representations. CMP, it is hypothesized, taps the syntactic level of representation, while probe recognition tasks tap the semantic level of representation. This is consistent with the fact that the CMP task typically finds activation immediately after the site of the EC, during the continued on-line processing of the input, while the probe task typically gets results only after sentence completion. Also, average response latency is faster for CMP than for probe recognition tasks. Fodor speculates on this basis that CMP is sensitive to activation by all and only syntactically represented NPs, while probe recognition is not informative about the sentence level. This is important because an EC is a syntactic entity. If this is so, it should be possible to

use the inventory of ECs to which CMP is responsive as a basis for choosing between linguistic theories with differing EC inventories.

Let us reconsider now in light of the linguistic levels hypothesis our interpretation of the results from Experiment 1. Suppose it is true that CMP taps only syntactic processes. Then a lack of sensitivity of CMP to the processing of control dependencies would imply that control is in fact merely a semantic phenomenon, rather than a syntactic one. This amounts to saying that PRO does not exist. While this would be inconsistent with GB theory, it would not be inconsistent with alternative nontransformational theories. In HPSG and other non-GB theories, nonfinite VPS without overt subjects are represented not as complete sentences, but simply as VPs. These theories do not assume the Extended Projection Principle of GB (see Section 2.2). Unlike GB, it is not necessary to assume an EC as the subject of a nonfinite verb when the subject is not overt, since in fact there is no subject position in such cases⁴. Thus a CMP experiment designed to tap the effects of plausibility factors on the processing of controlled PRO subjects would be incapable of

⁴ Neither the lack of an EC in this position nor the fact that the control relation is semantically-determined precludes the necessity to, in some way, identify the controlled element in syntactic terms (Pollard and Sag, 1994). In HPSG it is identified purely by SUBCAT features, in contrast with its GB representation as an EC.

showing any effects; if PRO is not represented in the syntax, then there is nothing that CMP could reveal. A null result for PRO, therefore, would be expected **regardless** of modularity issues.

Let us turn now to examine in detail whether there is CMP evidence for antecedent activation by controlled PRO.

Nicol (1988), using CMP with a lexical decision task, ran a series of experiments looking for antecedent activation by PRO, as subject of a complement clause. A sample stimulus set is given in (3). Because the verb in the matrix clause is an object control verb, the appropriate antecedent of PRO in (a), an active clause, is *the dentist*, while in (b), a passive clause, the appropriate antecedent of PRO is *the actress*:

- (3)
- a. The actress_i invited the dentist_j from the new medical center PRO_j to * go to the pa*rtly at the * mayor's * house*.
 - b. The actress_i was invited by the dentist_j from the new medical center PRO_i to * go to the pa*rtly at the * mayor's * house*.

Targets: stage/space, tooth/flood

Experiments checked for antecedent activation at five different probe positions; the first was immediately after the *to* that followed PRO, and four others were timed to appear at each of 500, 1000, 1200 and 1500 ms downstream from position 1. The observed results showed an unexpected

pattern of facilitation. There was no indication of reactivation of either antecedent, in either condition, until the third probe position, 1000 ms downstream from PRO. At +1000 ms there was activation of only the most recent filler, i.e. *the dentist* in both (a) and (b). It wasn't until +1200 ms that there was activation of the appropriate antecedent in each condition. Then at the final probe position, 300 ms later, there was activation, in both conditions, of *the actress*, the most distant filler, appropriate in condition (b) but inappropriate in condition (a). These results do not comport with the predictions of any current linguistic theory. Thus, the CMP evidence for PRO is inconclusive.

To account for these data, Nicol proposed that, since the antecedent choice for PRO is often dependent on semantics⁵, the ultimate decision as to an antecedent for PRO may depend on inferential processes. She pointed out, for example, that in many of the materials there was an inadvertent ambiguity between the intended construction with object control into a purpose clause, as in (4)a, and

⁵ There are semantic theories of control in the literature. For example, Culicover and Wilkins (1986) propose a theory of control within which an argument may be assigned more than one theta role, as long as one is of them is extensional (i.e. assigned by virtue of the perception of their physical properties) and the other intensional (i.e. assigned on the basis of a theory of human action). An infinitival complement is a VP and not a complete S'. Given this approach, PRO is a logical element and not at all a syntactic one; it follows by definition that the controller will be semantically assigned. However, since Nicol (1988) does not anywhere imply rejection of the Projection Principle, this explanation is not available to her.

subject control of a rationale clause, as in (4)b (see discussion of Jones' analysis in Section 2.5.2.1). She gave the following clear and simple example of this (not taken from the experiment⁶) shown in (4):

(4)

PURPOSE:

a. John_i hired Bill_j PRO_j to placate Susan.

RATIONALE:

b. John_i hired Bill_j PRO_i to placate Susan.

When a verb does not obligatorily take a complement clause as an object, inference may ultimately be needed to decide which of these analyses was intended. Nicol reasoned that the existence of the rationale clause as an option entails that the parser's analysis of a control construction must be based on semantics⁷ (even though, once the clause type has been semantically disambiguated, the

⁶ This ambiguity does not exist when a verb obligatorily subcategorizes for a complement clause. A post hoc examination of the Nicol experimental materials revealed that the two readings were available in only about half a dozen of the items. The following are three such examples; the material in parentheses has been added by me (in order) to indicate the ambiguity:

- i. The tailor from the shop on the outskirts of town had hired the plumber (in order) to work on the project.
- ii. The minister from the town on the other side of the lake had trusted the cook (in order to be able) to help out at the picnic.
- iii. The janitor of the large apartment building next door had bribed the tenant (in order) to fix the leaky faucet.

⁷ This is so regardless of whether the distinction between purpose and rationale clauses is a structural one. There is general agreement among linguists that the selection of a subject- or object-control complement construction is determined by the lexical semantics of the verb.

controller is fully determinate.) Assuming that CMP taps syntactic representations, then we should not be surprised at the lack of CMP effects in Nicol's materials. If this is correct, then the weak showing of PRO in her experiment does not necessarily signify a lack of linguistic reality.

In sum, it remains to be seen whether the CMP paradigm will reveal any activation of the controller of PRO when these confounding ambiguities are eliminated. To my knowledge no such experiment has yet been run, but one will be proposed in Section 5.4.

5.2.3 The PRO Conundrum and Modularity

It could be observed, in light of Nicol's (1988) findings, that there is no unequivocal evidence anywhere in the experimental literature for priming for the antecedent of PRO until at least 1000 ms downstream.⁸ The probe positions tested in Experiments 1 and 2 of this dissertation were, respectively, immediately after and 300 ms after the verb. Experiment 1 yielded differential results for *pro* and PRO, such that in the former case there were observed effects of pragmatic plausibility and in the latter there were none. This could not be accounted for (modularity aside) by a theory that posited neither *pro* nor

⁸ Fodor *et al*'s (1994) probe position was established with respect to word count rather than time in milliseconds, but it was quite possibly prior to 1,000 ms following PRO.

PRO. Only a theory that accepted *pro* but not PRO could predict the observed on-line difference. To the best of my knowledge, however, any linguistic theory that denies the existence of PRO also denies the existence of *pro*⁹. To the extent that this is so, denying the existence of PRO does not suffice to explain the experimental data.

5.3 Experiments 1 and 2: Possible Revisions

As always, hindsight is much stronger than foresight. There are several revisions of Experiments 1 and 2 which would possibly improve on the original design. These vary from minor changes in experimental procedure to re-thinking the linguistic properties of the sentential materials.

5.3.1 Test Points

Given an interest in the relative timing of experimental effects such as antecedent reactivation under different conditions, it is essential to test at enough points to catch the rise and fall of each effect. Their time courses might differ in interesting ways, even though at one or two points they look similar. Testing would be done, ideally, at **least** every 150 ms for materials presented at a normal

⁹ For instance, Pollard and Sag (1995) do not explicitly discuss this. They make only one brief mention of *pro*: "We also assume (as does Chomsky) that there are phonetically unrealized pronominal (*pro*) constituents, for example, null subjects of finite clauses in languages like Italian (p.252)". There is no further development of this idea in the book, so it is not clear whether they means that, just as for PRO, the analog of *pro* is not an NP node in the tree but a SUBCAT feature on the verb.

rate of speaking (Ni, Fodor, Crain, Shankweiler and Mattingly, 1993). This is, unfortunately, an incredibly laborious procedure requiring a very large subject pool (unless current methods could be adapted to intensive re-testing of a small subject group (see McElree and Griffith, 1995)). It is fairly certain, nonetheless, that more test points would provide a clearer pattern of results than Experiments 1 and 2 alone, concerning the relative influence of pragmatic bias on the processing of PRO, *pro* and overt pronouns.

In particular it would be interesting to present the naming target (with the same sentence materials and target words) somewhere prior to the test position used in Experiment 1, especially in the overt pronoun condition. In the PRO and *pro* conditions, the postverbal position is the first one at which there is evidence of having passed a phonetically null pronominal. For the overt pronoun condition, however, at that same position there has been a time lag, equal to the duration of the verb's enunciation, since having passed the relevant disambiguating information (which was the gender-marked subject pronoun). The effects seen in the overt pronoun condition were, contrary to expectation, not as clearly significant as those in the *pro* condition, and it was suspected that this was because they had already begun to decline from their maximum. (See Chapter 4.) On this assumption, there are two possible

outcomes that might be expected at an earlier probe position, after the gender-disambiguating pronoun, but before the context-biasing verb. One would be a stronger inhibition effect on the controls than the one that was found postverbally in Experiment 1. The other possibility would be that the immediate effect of gender disambiguation would be strong enough to yield a positive effect of facilitation for the gender-matched identity target.

5.3.2 Alternatives to Identity Priming

Another possible modification of the present experiments is suggested by the disadvantages inherent in the use of identity priming. The major disadvantage, as demonstrated by the results of Experiments 1 and 2, is that the identity priming effect can obscure positive facilitation effects. (See Section 4.3.5). In addition, there is a set of problems related to semantic associates. In this particular experimental design, both potential antecedents are performing the same action in the context sentence. The basis for a pragmatic bias in the test sentence is the expectation that one of the two persons is inherently more likely than the other to perform the action denoted by the verb in the test sentence. It is necessary, therefore, that there is greater compatibility between the plausible antecedent and the crucial verb. Some danger thus arises that there might be an associative relation between the

plausible antecedent and the verb, which would create a priming effect having nothing to do with antecedent activation. While Experiments 1 and 2 avoided the most blatant of semantic associate pairs, it is difficult to be confident that this factor was totally eliminated. An alternative approach would be to probe with a semantic associate of the antecedent that is not an associate of the verb. This would probably be useful, though the danger would not be totally eliminated; if the probe is a high associate of the noun and the noun is associated with the verb, there remains a potential link.

Another alternative to noun probes would be to include an adjective modifying each noun in the context sentence and then probe with the adjective. This technique has been used successfully (Cloitre and Bever (1988), Bever and McElree (1988), McElree and Bever (1989)) in a series of experiments using the visual probe recognition task. Because the canonical Spanish adjective is inflected for gender, potential antecedents should both be of the same gender¹⁰. The control probe would be a properly inflected adjective that had not appeared in the discourse. This design has the added advantage of allowing the use of the strongest semantic associations between the implicit

¹⁰ There is a class of common adjectives which do not inflect, but it is severely limited in size. Using the default (masculine) form of the adjective would not be satisfactory either, as this would conflict with feminine antecedents.

subject and the verb in the test sentence, as in (5), while still avoiding the problem of semantic association of the probe word to the verb, or semantically associated pairs of people (e.g. *doctor/nurse*).

(5)

The harried taxi driver(m) and the relaxed passenger(m) were chatting during the entire long ride. At the end of the trip, *pro* braked * directly in front of the tall apartment building.
Targets: harried/relaxed.

It is not certain, however, that this would produce significant effects. According to the logic of the cross-modal priming paradigm, the EC triggers a search for its antecedent; when it activates that NP, at least the head noun is primed, as are words associated with it in the mental lexicon, but it is not known whether other (less salient) aspects of the NP content are also primed. Though it is true that adjectives that have appeared in the noun phrase have been shown to induce reliable effects with the probe recognition task, there is no precedent, as far as I know, for the efficacy of adjectives in a cross-modal priming paradigm.

5.3.3 Issues Concerning Postverbal Subjects

As was discussed in Section 4.3.1.5, the acceptability of subject-verb inversion in Spanish entails that the processor, after passing a verb which has not been preceded by an overt subject, is faced with a temporary ambiguity as

to whether it has passed a full *pro* or an expletive (dummy) *pro*. Experiments 1 and 2 were carried out under the assumption that the processor, following the Minimal Chain Principle (DeVincenzi, 1991), would resolve this ambiguity in favor of the full preverbal *pro* in the context of a finite verb and a full preverbal PRO in the context of an infinitival or gerundive verb. It would be desirable, nonetheless, to remove any possible effects of such an ambiguity where it is not called for by the experimental design.

One approach to eliminating this ambiguity would be to run an experiment in a language such as Brazilian Portuguese which, while permitting subject *pro*¹¹, does not allow subject-verb inversion (Chao 1980). At the point of having passed the verb, then, it would be perfectly evident to the parser that a null subject had been present in the string, and in accounting for the data it would not be necessary to invoke the Minimal Chain Principle to exclude the expletive *pro* analysis.

¹¹ There is, however, another relevant difference between Brazilian Portuguese (BP) and Spanish. Tarallo (1983) discusses a trend, developing since the mid 19th century, towards the disappearance of subject *pro* drop in BP. The extensive use of overt subject pronouns is prevalent in colloquial Brazilian Portuguese today, along with the general disappearance of object pronouns, as illustrated by the following construction (example from Tarallo):

O café de lá tão ruim. Eu não consegui tomar *e*.
'The coffee there is so bad. I could not drink.'

It was also noted in Section 4.3.1.5 that there exist in Spanish certain conditions under which a lexical subject of a nonfinite verb is licensed, as shown by the examples of nominative absolutes in (6) (from Hernanz, 1982)¹²:

- (6)
- a. Nos pusimos en camino al salir el sol.
 we put ourselves on the road at to come out the sun
 'We started out on the road upon the sun rising.'
 - b. Al salir el sol, nos pusimos en camino.
 at to.come out the sun, we put ourselves on the road
 'Upon the sun rising, we started out on the road.'

As shown in (7), an explicit subject may not appear in preverbal position; as shown by (8), it is inadmissible in a complement clause, appearing to be restricted to

¹² According to Hernanz (1982) the explicit NP appears precisely in those cases in which the principal verb fails to impose obligatory coreference on the subject of the subordinate clause, so that recovery of the content of the null subject would otherwise be impossible. This follows from Hernanz' functional explanation for the existence of null subjects of nonfinite verbs in the first place. She argues that it is not the infinitive that licenses the null subject of the embedded predicate, but that it is the semantics of the matrix verb that allows the subordinate subject to be recovered from the matrix clause, so that the verb in the subordinate clause can lack tense and subject features.

subordinate adverbial clauses¹³ (Hernanz and Brucart, 1987):

- (7) *Al el sol salir, los viajeros se pusieron en camino
 *'Upon the sun to rise, we started out on the road'

- (8) *María quiso ir Luis al juicio.
 Maria wanted to go Luis to the judge.

Use of an explicit post-gerundive or post-infinitival subject in an adjunct clause is a stylistic choice (more literary than colloquial), although the infinitive is freer and less stylistically marked than the gerundive (Fernández Lagunilla, 1987). In either case, the post-verbal subject is used to indicate contrast, to emphasize that the subject of the adjunct is distinct from the subject of the matrix verb. Hence it cannot be coreferential with the matrix subject, as shown in (9):

¹³ Why this is so, and how the constraint can be imposed, is not entirely clear. Rigau (1992), emphasizing the temporal quality of these adverbials, argues that they originate as sisters of TP (cf. Enç, 1987). When they are preverbal they appear in a theme or topic position, and because the tense node is 'very weak' in these constructions, the verb must incorporate with the preposition (e.g. *al*, *antes de*); this explains the obligatorily postverbal position of the subject. Rigau argues further that the AGR node in this construction is syntactically fully expressed, despite the fact that it is morphologically mute, and that the subject is not PRO but *pro*, which receives nominative Case from AGR. Similarly, Fernández Lagunilla (1987) argues for a more or less 'empobrecido' (impoverished) *pro* subject of these clauses.

(9)

- a. **Maria_i se descalzó al llegar ella_i a casa.*
Maria_i took off her shoes on to arrive she_i at home.
- b. **Maria_i se descalzó, llegando ella_i a casa.*
Maria_i took off her shoes, llegando she_i at home
 'Maria took off her shoes upon arriving home.'

Like Spanish, Italian also admits post-verbal lexical subjects of nonfinite verbs (Rizzi, 1982). While the construction is again limited to a relatively formal style, in Italian the infinitival variant is more highly marked than the gerundive. Unlike Spanish, these lexical NPs are limited in Italian to the context of an auxiliary, appearing between the aspectual gerundive (or infinitival) auxiliary and the past participle¹⁴.

As shown in the examples in (10) (from Rizzi), the ordering *NP Aux* is unacceptable for many speakers, and very marginal for others.

¹⁴ This can also, under fairly highly styled conditions, appear in English, as in (i) below. It is marginal unless it is in perfective aspect, with the main verb in participial form and the auxiliary verb in the gerundive, as shown in (ii). It is limited to preverbal position, as shown in (iii).

- i. The sun having risen, we started out on the road.
 ii. ??The sun rising, we started out on the road.
 iii. *Having risen the sun, we started out on the road.

- (10)
- a. *(?)Mario avendo accettato di aiutarci, potremo risolvere il problema.
 'Mario having accepted to help us, we'll be able to solve the problem.'
 - b. Avendo Mario accettato di aiutarci, potremo risolvere il problema.

Rizzi's analysis of the facts illustrated in (10) invokes a special Case assignment process in Italian whereby Nominative Case is assigned to an NP to the immediate right of an auxiliary. An extension of such an analysis to account for the Spanish facts is not manifest, since in Spanish the postverbal subjects can appear without any auxiliary verb in the clause. Whatever the theoretical status of the Spanish constructions, it seems safe to expect that the processor, following its Minimal Chain Principal, will posit a full preverbal PRO as subject of a nonfinite verb.

5.4 PRO v. pro in Subjunctive Clauses

As noted in Section 5.2.2, no experiment has yet demonstrated whether there is antecedent priming for PRO in an unambiguous, obligatory control construction. A phenomenon involving disjoint reference effects in Spanish

(and other Romance) subjunctive clauses¹⁵ offers another opportunity to compare processing of PRO with that of *pro* in nicely matched sentences.

Verbs that express volition (e.g. *aconsejar* ('advise'), *preferir* ('prefer'), *querer* ('want'), *sugerir* ('suggest')) are lexically specified for an embedded complement clause. When that embedded clause is tensed it is in the subjunctive mood, as indicated by the verbal morphology, and its subject must be distinct in reference from that of the matrix clause, as shown in (11)a. When the clause is infinitival, as in (b), then its subject must be coindexed with the subject of the matrix clause.

Consider the examples in (11):

(11)

- a. El estudiante_i piensa que el maestro_j prefiera que *pro*_{i/*j/k} traduzca el poema.
The student thinks that the teacher prefers that (*pro*) translate(SUBJ) the poem.
- b. El estudiante_i piensa que el maestro_j prefiera *PRO*_{*i/j/*k} traducir el poema.
The student thinks that the teacher prefers *PRO* to translate(INF) the poem.

The *pro* in (11)a, unlike the *pro* in Experiments 1 and 2, is constrained in that it must **not** corefer with *el maestro*. It is free to refer either to *el estudiante* or to an

¹⁵ The syntactic analysis of these facts is beyond the scope of this dissertation. For discussion see Picallo (1985), Suñer (1986), and Kempchinsky (1987).

antecedent outside the sentence¹⁶. Though it is ambiguous, there is nothing unnatural about this sentence. In (11)b, the PRO and *el maestro* **must** corefer, as required by control theory.

The noted gap in the psycholinguistic literature could be filled by an experiment using sentences like (11)a and (11)b to determine whether cross-modal priming in fact reflects selection of the grammatically correct antecedents for the controlled ECs that appear in them. These are excellent experimental constructions because they make a very well matched pair, in which both conditions contain the same matrix clause. Further, they are structurally unambiguous, avoiding the problem caused by the possibility of purpose clauses. Such a study could provide the much needed data showing antecedent activation for PRO when it is unambiguously controlled. At the same time it could provide data for antecedent activation for *pro* when it is grammatically constrained.

Further, there are two other classes of verbs which show no disjoint reference constraint, although they take subjunctive complements: verbs of emotion (e.g. *sentir, esperar, lamentar, temer*) and verbs expressing doubt or disbelief (e.g. *no creer, dudar*). In (12)a, for example, the *pro* **can** freely corefer with *el maestro*, though it need

¹⁶ A *pro* intended here to have arbitrary reference would be preceded by the clitic *se*.

not; in (12)b PRO is as ever, controlled by the matrix subject:

- (12)
- a. El maestro_i espera que *pro*_{i/j} pueda traducir el poema.
The teacher hopes that (*pro*) can[SUBJ] translate[INF] the poem.
 - b. El maestro_i espera PRO_{i/*j} poder traducir el poema.
The teacher hopes PRO to be able to translate the poem.

The same facts pertain to (13), where there is free reference of the *pro* in (a), and obligatory control in (b):

- (13)
- a. Ana_i duda que *pro*_{i/j} sea la persona mas apta para el puesto.
'Ana doubts that s/he is[SUBJ] the best person for the job.'
 - b. Ana duda PRO ser la persona mas apta para el puesto.
'Ana doubts PRO to be the best person for the job.'

There are interesting and unresolved issues regarding the relative roles of syntax and semantics in the creation of these disjoint reference facts. The semantics of the verbs in the *preferir* ('prefer') class, (as in (11)), is such that the referent of the subject in the complement clause is influenced, by the referent of the subject of the matrix clause, to perform some action (cf. Pollard and Sag, 1994). The status of these facts in the grammar could be further

elucidated by cross-linguistic processing studies. If they are purely semantic facts (Suñer, 1986), then their processing consequences should be consistent across all languages whose verbs have these same meanings¹⁷. If, however, they are more properly considered to be morpho-syntactic facts, then we would expect to see a contrast between English on the one hand, and Spanish and Catalan on the other. English, unlike Spanish, has no overt inflection to mark the subjunctive, as shown in (14) (a) and (b):

- (14)
- a. The (male) teacher_i prefers that he_{i/j} translate the poem.
 - b. The (male) teacher_i prefers PRO_{i/j} to translate the poem.

A further experiment could be designed to determine whether the processor is sensitive to the differing constraints on these verb classes with respect to coreference.

Neuroimaging technology using event related potentials has been shown to distinguish between reactions to syntactic and semantic anomalies (Osterhout and Holcomb, 1990). Use

¹⁷ Some examples, such as (i) below, are difficult to accept:

- i. John_i is insisting that he_{j/s} leave immediately.

These seem to improve when the lower verb denotes an action that isn't usually under the control of the higher subject, as in (ii):

- ii. John_i is insisting that he_{j/s} get the prize this year.

This distinction seems to support the idea that the phenomenon is indeed based on semantics.

of this methodology, to examine the pattern of responses to anomalies in the constructions above, could illuminate the respective role of syntax and semantics in determining the antecedents of the ECs, and whether that role is universal or language-specific.

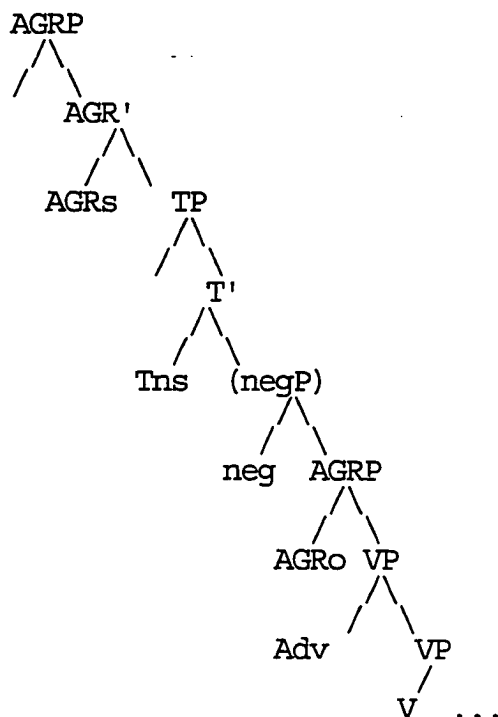
5.5 Agreement Issues

Experiment 1 demonstrated an effect of plausibility on the processing of *pro* and overt pronouns, in contrast with a lack of the same effect on the processing of PRO. In the context of GB theory that contrast amounts to a processing distinction between a null subject in a Case-assigning verb phrase and a null subject in a non-Case-assigning verb phrase. Given the more current proposal within the Minimalist framework (Chomsky, 1991) that PRO has Null Case (Chomsky and Lasnik, 1991) there appears to be no such distinction to be made. Thus, if the more recent linguistic theory is correct, some other explanation must be found for the experimental results. I propose for consideration the following hypothesis, that feature checking, in the presence of overt agreement morphology, is a major contributing factor to the processing effects that have standardly been attributed simply to antecedent reactivation at the site of a referentially-dependent NP. This hypothesis is inspired by relatively recent developments in phrase structure theory which have made

possible the more refined hypotheses of the Minimalist program about agreement checking and Case assignment. The next few paragraphs will be a brief review of these developments.

Following Pollock (1989), it is now standardly assumed that VP is dominated by a series of maximal functional projections, including AGRP, the agreement projection, and TP, the tense projection (the split INFL hypothesis). Belletti (1990) argues that the tree order should be a mirror image of the verb/tense/agreement morphemes in Romance; thus AGRP dominates TP. Chomsky (1991), citing both Belletti and Pollock, argues for two kinds of Verb/NP agreement. The maximal functional projection is the AGRP whose head is AGRS; this dominates TP (and possibly other functional projections such as NegP). Immediately dominating VP is a second AGRP, and its head is AGRO. This (presumably universal) configuration is illustrated in (15):

(15)



Agreement is now understood to be a reflection of the Spec-head relation that exists at S-structure¹⁸ between the head of an agreement projection and an NP. At S-structure, the subject NP has moved from its VP-internal base-generated position into the Spec position of AGRSP; the object NP is in the same relation with AGROP. The finite verb has adjoined to the head of AGRS, where it must move in order to check its Phi features; the inflected verb is thus the surface manifestation of AGR and Tense. Now the subject NP is in a Spec-head relation with the finite verb,

¹⁸ What was called S-structure in GB corresponds with what is called Spell-Out in the new minimalist framework.

and it is via this relation that it gets (or is checked for) Nominative Case¹⁹.

The on-line sentence processor receives the linguistic stimulus in a left-to-right fashion. At the point at which a verb is encountered, information about agreement, as well as argument structure, is available in the string²⁰ and, presumably, available to the processor. The impact of agreement morphology on the coreference processor has been suggested by a series of experiments that used a probe recognition task to look for antecedent priming by NP-trace (Elías-Cintrón *et al*, 1995). As a secondary result, they obtained faster reaction times for an NP of which an adverb was predicated than for an NP of which an adjective was predicated. Examples of the relevant conditions are given in (16):

¹⁹ See Chomsky (1993) for details on the AGR-based Case theory.

²⁰ Complications arise when considering constructions in which the finite verb encountered is an auxiliary, or a raising verb (e.g. *seems*). This was never the case in Experiments 1 and 2, and of course can be carefully controlled for in any experiment.

(16)

a. Adverb:

Los graduados de la famosa escuela estaban abajo.

'The graduates of the famous school were downstairs.'

b. Neuter Adjective:

Los graduados de la famosa escuela estaban inconformes.

'The graduates of the famous school were dissatisfied.'

c. Common Adjective:

Los graduados de la famosa escuela estaban inquietos.

'The graduates of the famous school were restless.'

Probe: graduados

Spanish adverbs bear no inflectional marking, while adjectives fall into two classes: 'common' adjectives, which are marked for both gender and number, and 'neuter' adjectives, marked for number only. The probe recognition latencies showed a significant contrast between both kinds of adjectives, on the one hand, and the unmarked adverbs, on the other hand. Elías-Cintrón *et al* attribute this contrast to a complexity effect caused by agreement marking. In a follow-up experiment in English, they found no differential effect when comparing adjectives and adverbs in comparable sentences. This supports their hypothesis that it was indeed the agreement marking, nonexistent in English, that was driving the observed effect in Spanish.

The results from Experiments 1 of this dissertation, which employed a cross modal priming task, seem to suggest

that the subject-verb agreement relation agreement can be reflected in some very rapid on-line effects. By the hypothesis which I am developing here, subject-verb agreement checking is initiated in the presence of overt verbal inflection; agreement features on co-indexed elements constitute the syntactic input that the coreference component of the language module will act upon and be constrained by. One account congruent with the observed data patterns would be that agreement morphology has an immediate effect of facilitation on antecedent activation, but that it has a concurrent effect of processing complexity. As observed by Elías-Cintrón *et al*, what their data suggest in this regard is that, should there be a 'morphological priming' as well as a complexity effect, the former is the weaker of the two. ²¹

In Experiment 1 of this dissertation the complexity factor might have been obscuring a facilitation effect for the identity target words, and vice versa. In the form-matched control target conditions, then, where there was no

²¹ While their follow-up experiments do a good job of addressing many of the confounds from their Experiment 1, it is still unclear why one single instance of agreement inflection (i.e. neuter adjective v. adverb) should make such a significant difference in response times, given the plethora of agreement already existent in the Spanish sentences. Howard Kurtzman (personal communication) has suggested that while the plethora of agreement in Spanish sentences does add up to a considerable increase in complexity, there isn't necessarily a linear relation between the amount of agreement and response time. Further, the agreement relation examined here is a long-distance one, not well understood by linguists, between subject NP and predicative adjective, which may produce larger effects than other agreement relations.

facilitation of the target resulting from the antecedent activation, the complexity effect was observable. It is possible that targets which share gender (especially in combination with global similarity in form) with the reactivated antecedents would be inhibited under these conditions. This would apply only to finite AGR, hence in the context of pronouns and lexical NPs, because nonfinite verbs are not in this relation with AGR. Since there are no AGR features to be checked in an untensed verb phrase, no inhibition effect was observed in the processing of PRO²².

My proposal here is that the coreference operations of the language processing module are triggered not by the presence of a referentially-dependent NP, but by the presence of overt agreement morphology on the verb. Neither PRO, the minimal pronominal, nor the untensed functional projection in a nonfinite clause, has any overt features on it, so at that position there is nothing to be checked. Obviously this proposal calls for expansion as

²² Within the Minimalist framework, Null Case is assigned to the PRO subject of a nonfinite verb via its Spec-head relation with [-finite] Tense. Explication of the motivation for this change, as well as the details of its instantiation, is beyond the scope of this dissertation. (Cf. Chomsky and Lasnik, 1991).

well as empirical evidence. It is certainly not clear precisely what this implies for the processing of PRO²³.

In conclusion, the experimental findings reported here suggest a modular language processor which gives priority to the processing of syntactically-constrained phenomena. At the point of encountering a finite verb, that verb's subject can be output to the central processor for integration with pragmatic information; this is true whether the NP is overt or null. At the point of encountering a nonfinite verb, if the controller for that verb's subject has not yet been encountered in the string, the integration of pragmatic clues as to the NP's antecedent is delayed. Further experimentation will be required to determine precisely how long that delay will be maintained.

²³ It might be speculated that the erratic activation pattern observed by Nicol (1988) for the antecedent of controlled PRO suggests that on-line agreement checking occurs only when the features on the controller are marked, i.e. feminine.

Appendix A Postverbal Fragment Completion Task

Aquí tienes algunos párrafos inacabados. Intenta completarlos de cualquier manera que te parezca bien. Un párrafo que empiece como el modelo se podría completar con, por ejemplo, una de las dos maneras mostradas. No hay ninguna respuesta que sea mejor que otra - emplea la imaginación.

Modelo:

La profesora de arte se ha enterado de que un alumno suyo se ha enamorado de ella. Cuando entró ...

- ... en su oficina, encontró un ramo de flores.
- ... en la clase, alguien le chifló.

1. Los hijos del abogado están preparando una fiesta para celebrar el cumpleaños de su papá. Cumplirá ...

2. Ayer en la farmacia, la lavandera y el boticario se contaron las últimas novedades del pueblo. Al final, después de comprar...

3. Durante tres años, los novios han mantenido su relación oculta, debido a que trabajan para la misma empresa. Ahora, se van a ...

4. La ciega y el pintor fueron juntos a un nuevo restaurante en el centro de la ciudad. Leyendo ...

5. La anfitriona estaba nerviosa al invitar al dignatario visitante a cenar. Se superó, sirviendo ...

6. El obrero y la inquilina convinieron ayer el precio del arreglo de la casa. Esta mañana, tras reparar ...

7. El estudiante necesitaba que alguien escribiera a máquina su tesis. Tenía suerte porque ...

8. La experta enfermera y el chiquillo travieso cogido de las manos se dirigían hacia el consultorio. Pataleando ...

9. El domingo pasado, la maestra paso la mañana jugando con su joven nieto. Después del almuerzo, mientras él echaba la siesta,...

10. La psicóloga y el prisionero hablaron del asunto que había causado la detención. El año pasado, al robar ...

11. El vendedor y la cliente cambiaron impresiones sobre la subida de los precios. Apenas él cobró ...
12. El ingeniero de sonido y la estrella famosa estaban preparados para la grabación del disco. Cantando ...
13. En la fiesta de cumpleaños el payaso se acercó a un tímido niño. Se puso a entretenerlo haciendo ...
14. La dueña de la casa en venta y el músico interesado en comprarla regatearon por el precio durante varios días. Por fin, al vender ...
15. Los padres de mi amigo han conseguido realizar su sueño de viajar por el Caribe. Antes de hacer las reservaciones, ...
16. La contable y el taxista charlaron durante todo el viaje. Al final del trayecto, frenando ...
17. El cartero se detuvo un buen rato charlando en el portal con la vecina. Por fin, se despidieron y él ...

Results of Postverbal Completion Test

	Null	Matr ix	Post v	Ambi	Pres 'l	Bad	Tota l
Gerund							
1	7	6	4	3	0	0	20
2	6	7	1	4	2	0	20
3	9	6	1	2	2	0	20
4	6	10	1	3	0	0	20
sub	28	29	7	12	4	0	80
	35%	36%	9%	15%	5%	0%	
Infinitive							
5	12	7	0	1	0	0	20
6	8	9	1	2	0	0	20
7	15	2	1	1	0	1	20
8	7	8	4	1	0	0	20
sub	42	26	6	5	0	1	80
	53%	33%	8%	6%	0%	1%	
Total							
Total	70	55	13	17	4	1	160
% of Total							
% of Total	44%	34%	8%	11%	3%	1%	100%

Appendix B: Materials, Experiments 1 and 2

LEGEND: B=PRO L=pro O=Overt pronoun F=Filler

INSTRUCCIONES:

En la tarea que vas a realizar, oirás por los auriculares una serie de párrafos breves que se irán presentando sucesivamente, sin que tengan relación unos con otros. Deberás prestar atención a lo que se dice en cada párrafo y, al mismo tiempo, fijar la vista en la pantalla, ya que de vez en cuando aparecerá una palabra de forma rápida en el centro de la misma. En cuanto veas la palabra, deberás leerla en voz alta lo antes posible.

Ahora vas a hacer unos ejemplos de práctica para que puedas familiarizarte con la tarea. Recuerda que lo que debes hacer simplemente es escuchar atentamente los párrafos por los auriculares, fijar la vista en la pantalla, y en cuanto aparezca allí una palabra, leerla en voz alta inmediatamente.

PRACTICA:

F El vigilante del edificio conversaba con una residente cuando sintieron un ruido al fondo de la planta. Ella le acompañó para inspeccionar la última sala del pasillo.

Probe: camisa

F Hace dos semanas que la bibliotecaria ha tenido la entrevista para una puesto de trabajo muy atractivo. El gerente le dijo que le llamaría para darle los resultados.

Probe: almuerzo

F La costurera y el cartero se entretuvieron un buen rato charlando en el portal. Por fin, se despidieron y él repartió el resto de la correspondencia.

Probe: cartero

F La taquígrafa está muy preocupada por su hermano menor. Desde que murió su padre, ha dejado de trabajar. Nunca tiene un centavo, y ella teme que esté tomando drogas.

Probe: basura

F Aunque la cita era para las dos, la comerciante de arte estaba lista para recibir al famoso artista desde el

mediodía. Siendo tan cumplidora, se ha hecho una buena clientela.

Probe: comerciante

EXPERIMENTO:

F El sindicalista discutía con la representante de la compañía sobre el nuevo contrato. Reiteró su posición y demandó ciertos derechos.

Probe: cuaderno

F La patinadora y su abuelito pasaron el día felizmente en el hermoso parque. Mientras andaba ella vigorosamente, el tenía que descansar cada dos por tres.

Probe: pregunta

F El coronel y la servienta hicieron el plan del día. El coronel ordenó una limpieza general.

Probe: intento

F La jefa del programa de literatura ha invitado a una famosa poeta suiza para presentar sus obras a los universitarios. Ella leerá sus poemas en alemán.

Probe: coro

1. Después de la comida, el mesonero y la forastera discutieron sobre el precio de la consumición. Una vez resuelto el asunto,

- (B) abonando malhumoradamente el total de la cuenta, se levantó de la mesa.
- (L) mientras abonaba malhumoradamente el total de la cuenta, se levantó de la mesa.
- (O) mientras ella abonaba malhumoradamente el total de la cuenta, se levantó de la mesa.

Probes: mesonero/mostacho/forastera/frambuesa

F Los hijos del profesor están preparando una fiesta para celebrar el cumpleaños de su papá. Aunque cumplirá 70 años en julio, no parece tan mayor.

Probe: imagen

F El sastre y su mujer se conocieron en una discoteca que ella frecuentaba mucho. Salieron varias veces a bailar, y él se enamoró rápidamente de la hermosa señorita.

Probe: madrina

2. Ayer en la farmacia, la lavandera y el boticario se contaron las últimas novedades del pueblo. Al final,
- (B) tras comprar apresuradamente unas pastillas para la tos, salió corriendo a la calle.
 - (L) así que compró apresuradamente unas pastillas para la tos, salió corriendo a la calle.
 - (O) así que ella compró apresuradamente unas pastillas para la tos, salió corriendo a la calle.

Probes: lavandera/legalidad/boticario/brazalete

F El jardinero del hotel es también un buen pescador. A esta tarea dedica, en general, los domingos, vendiendo luego a sus vecinos las truchas que ha pescado.

Probe: chiste

F Durante 3 años, los novios han mantenido su relación oculta, debido a que trabajan para la misma compañía. Ahora, se van a casar y no saben si deben dar la noticia a sus jefes.

Probe: desgracia

3. El sábado pasado, la maestra y el bebé jugaron juntos toda la tarde. Antes de la cena,
- (B) calentando el agua para el baño en una olla grande, sintió mucho cansancio.
 - (L) mientras calentaba el agua para el baño en una olla grande, sintió mucho cansancio.
 - (O) mientras ella calentaba el agua para el baño en una olla grande, sintió mucho cansancio.

Probes: maestra/montaña/bebé/palo

F El historiador necesitaba que alguien escribiera a máquina su tesis. Como es una mecanógrafa de primera clase, su hija le ayudó amablemente.

Probe: horizonte

4. El ministro de relaciones exteriores y una escritora refugiada tuvieron ayer una larga entrevista. Durante el curso de la misma,

- (B) al solicitar asilo político en el país, habló de unos terribles abusos.
- (L) cuando solicitó asilo político en el país, habló de unos terribles abusos.
- (O) cuando ella solicitó asilo político en el país, habló de unos terribles abusos.

Probes: escritora/expansión/ministro/mosquito

5. El malvado mafioso y la inquieta tendera estaban sentados en los asientos traseros del coche.

- (B) Amenazando con un chantaje violento, lanzó una mirada cruel.
- (L) Mientras amenazaba con un chantaje violento, lanzó una mirada cruel.
- (O) Mientras él amenazaba con un chantaje violento, lanzó una mirada cruel

Probes: tendera/cazuela/mafioso/mortero

F Durante diez años el asmático y su terapeuta mantenían una visita semanal. Sin embargo, ha fallecido finalmente a causa de la enfisema.

Probe: sandalia

6. La directora de personal y el candidato inexperto hablaron sobre el nuevo trabajo.

- (B) Aconsejando discreción y prudencia, contempló la foto del fundador.
- (L) Mientras aconsejaba discreción y prudencia, contempló la foto del fundador.
- (O) Mientras ella aconsejaba discreción y prudencia, contempló la foto del fundador.

Probes: directora/bicicleta/candidato/vestíbulo

7. La azafata y el viajero se habían saludado unos pocos minutos antes del despegue. Luego,
- (B) anunciando las instrucciones de seguridad, le sonrió.
 - (L) mientras anunciaba las instrucciones de seguridad, le sonrió.
 - (O) mientras ella anunciaba las instrucciones de seguridad, le sonrió.

Probes: azafata/armonía/viajero/volumen

F Antes de visitar a su abuela, el pastor se detuvo en la peluquería donde se hizo cortar el pelo y afeitarse la barba. Al encontrarse, ella casi no le reconoció.

Probe: alcaldesa

F La boda del embajador y su novia se celebró en la capilla del palacio. De casi todos los preparativos, se ocupó la madre de la novia con gran diligencia.

Probe: bizcocho

8. Por la mañana en el mercado, el carnicero y la portera se entretenían con los últimos cuchicheos del barrio. Al final de la conversación,
- (B) tras pagar en efectivo por toda la compra, se despidió hasta el día siguiente.
 - (L) así que pagó en efectivo por toda la compra, se despidió hasta el día siguiente.
 - (O) así que ella pagó en efectivo por toda la compra, se despidió hasta el día siguiente.

Probes: portera/tableta/carnicero/costumbre

9. La locutora del telediario y el famoso boxeador se citaron en el estudio de televisión para celebrar una entrevista.
- (B) Al preguntar primeramente sobre cosas de la infancia, se encontró sin respuesta.
 - (L) Cuando preguntó primeramente sobre cosas de la infancia, se encontró sin respuesta.
 - (O) Cuando ella preguntó primeramente sobre cosas de la infancia, se encontró sin respuesta.

Probes: locutora/limonada/boxeador/paraguas

F La deportista y su amigo van todos los días al gimnasio. Aunque él toma bastante cerveza, parece estar en buena forma.

Probe: galería

10. El dentista de la clínica y la ansiosa pianista se prepararon para la limpieza anual.
- (B) Examinando la radiografía de todos los dientes, descubrió una muela picada.
 - (L) Mientras él examinaba la radiografía de todos los dientes, descubrió una muela picada.
 - (O) Mientras examinaba la radiografía de todos los dientes, descubrió una muela picada.

Probes: dentista/bautismo/pianista/papelera

F Antes del espectáculo, el mago y la trapeceista hicieron una apuesta. Luego, cuando ella cayó repentinamente en la red, supo que había perdido.

Probe: bocadillo

11. El joven sordomudo y su diligente tutora se presentaron ante la oficina de servicios sociales.
- (B) Exponiendo una larga lista de problemas, ganó la atención que buscaban.
 - (L) Mientras exponía una larga lista de problemas, ganó la atención que buscaban.
 - (O) Mientras ella exponía una larga lista de problemas, ganó la atención que buscaban.

Probes: tutora/corona/sordomudo/separador

F La doncella estuvo todo el día limpiando la casa del aristócrata. Dado que él era muy exigente, quería tener todo listo antes de su llegada.

Probe: leche

F El agricultor y la visitante dieron un paseo por el huerto. A la puesta del sol, mientras él regaba los tomates, ella sacó unas buenas fotos.

Probe: campesino

12. El bañista y la dermatóloga terminaron la consulta sobre las quemaduras de sol.
- (B) Recetando una crema analgésica, se despidió.
 - (L) Apenas recetó una crema analgésica, se despidió.
 - (O) Apenas ella recetó una crema analgésica, se despidió.

Probes: dermatóloga/disertación/bañista/desfile

13. El maldito borracho y la viuda piadosa oyeron la mala noticia por el telediario de las nueve.
- (B) Rezando toda la noche por una resolución del problema, sintió más alivio.
 - (L) Mientras rezaba toda la noche por una resolución del problema, sintió más alivio.
 - (O) Mientras ella rezaba toda la noche por una resolución del problema, sintió más alivio.

Probes: viuda/tabla/borracho/ventanal

F La joven atleta estuvo discutiendo con el distinguido decano sobre el suspenso de matemáticas. Al rectificar la nota en las actas, cumplió con su obligación.

Probe: pájaro

F Cuando llegó al pueblo, la editora preguntó por la dirección a una peatona. Buscando sin un plano la casa de su tío, se había perdido.

Probe: función

14. La refinada condesa y el rufián grosero estaban asomados al balcón del museo.
- (B) Tras escupir despiadadamente hacia el suelo, lanzó una carcajada.
 - (L) Cuando escupió despiadadamente hacia el suelo, lanzó una carcajada.
 - (O) Cuando él escupió despiadadamente hacia el suelo, lanzó una carcajada.

Probes: rufián/raudal/condesa/clavija

F Toda la gente que asistió a la reunión de vecinos esperaba que hablara el presidente. Iba a informar sobre la propuesta de venta del edificio a una constructora.

Probe: emblema

15. La ciega y el pintor fueron juntos a un nuevo restaurante en el centro de la ciudad.

- (B) Leyendo en voz alta los platos especiales del día, decidió qué pediría.
- (L) Mientras leía en voz alta los platos especiales del día, decidió qué pediría.
- (O) Mientras él leía en voz alta los platos especiales del día, decidió qué pediría.

Probes: pintor/bigote/ciega/salsa

F El principiante y el monitor bajaban juntos a la pista de esquiar. Cuando se cayó, el monitor le seguía muy de cerca.

Probe: decoración

F Al llegar a la casa, la pareja se dió cuenta de que se les había perdido la llave. Afortunadamente, les esperaba su hijo menor, que les abrió la puerta.

Probe: ordenador

16. El sacerdote y la drogadicta pasearon juntos alrededor de la plaza mayor.

- (B) Recomendando fuerza de voluntad y paciencia, ofreció toda la ayuda necesaria.
- (L) Mientras recomendaba fuerza de voluntad y paciencia, ofreció toda la ayuda necesaria.
- (O) Mientras él recomendaba fuerza de voluntad y paciencia, ofreció toda la ayuda necesaria.

Probes: sacerdote/sindicato/drogadicta/ventanilla

F Desde que han nacido los gemelos, la bailarina no ha podido adelgazar. Antes solía hacer ejercicios diariamente, pero ahora no tiene ni tiempo para peinarse.

Probe: hierba

17. Un pobre indigente y una acaudalada turista fueron las únicas personas que entraron en la tienda de recuerdos en toda la tarde.

- (B) Tras adquirir varios artículos de artesanía, salió a pasear.
- (L) Así que adquirió varios artículos de artesanía, salió a pasear.
- (O) Así que ella adquirió varios artículos de artesanía, salió a pasear.

Probes: turista/ternura/indigente/electrodo

F La farmacéutica y su hermana piensan ir al mismo hipnotizador que vió a su primo para que dejase el hábito de fumar. Era un excelente sujeto y ha sido totalmente curado.

Probe: camarada

18. La ecologista y el centinela forcejeaban en la entrada de la central nuclear. De repente,

- (B) disparando impasiblemente hacia lo alto, acalló las protestas.
- (L) Mientras disparaba impasiblemente hacia lo alto, acalló las protestas.
- (O) Mientras él disparaba impasiblemente hacia lo alto, acalló las protestas.

Probes: centinela/sombreado/ecologista/estantería

F A la joven y a su abuelo no les gusta vivir juntos. Parece que él siempre está quejándose de lo que hace ella, pues por lo normal ella no para nunca en casa.

Probe: utensilio

19. La experta enfermera y el chiquillo travieso cogido de las manos se dirigían hacia el consultorio.

- (B) Pataleando con mucha furia hacia todas partes, le agotó la paciencia.
- (L) Mientras pataleaba con mucha furia hacia todas partes, le agotó la paciencia.
- (O) Mientras él pataleaba con mucha furia hacia todas partes, le agotó la paciencia.

Probes: chiquillo/chaquetón/enfermera/esperanza

F Después de que la tenista se torció el tobillo, los doctores le recomendaron guardar reposo durante unos días. Ahora ella, que es muy activa, encuentra difícil seguir sus recomendaciones.

Probe: naturaleza

20. La presentadora y el realizador estaban preparados para la emisión en directo del programa concurso. Una vez en el aire,
- (B) tras saludar con una sonrisa a los telespectadores, dió paso a los nuevos concursantes.
 - (L) así que saludó con una sonrisa a los telespectadores, dió paso a los nuevos concursantes.
 - (O) así que ella saludó con una sonrisa a los telespectadores, dió paso a los nuevos concursantes.

Probes: presentadora/participación/realizador/rectángulo

F Tanto el cirujano como la anestesista eran responsables por haber descuidado al paciente. Aunque ella quería atribuirse toda la culpa, él insistía en admitir su propia responsabilidad.

Probe: mentón

21. La nadadora y su entrenador habían trabajado mucho para preparar el reciente campeonato.
- (B) Al ganar magníficamente la primera carrera, sintió mucha alegría.
 - (L) Cuando ganó magníficamente la primera carrera, sintió mucha alegría.
 - (O) Cuando ella ganó magníficamente la primera carrera, sintió mucha alegría.

Probe: nadadora/nicotina/entrenador/escaparate

F La asistente del oculista era además gran amiga que le ayudó siempre en los momentos difíciles. Al final se han enamorado y quieren contraer matrimonio civil.

Probe: cucharada

22. La arrogante millonaria y el huérfano abandonado llegaron al mismo tiempo a la puerta del restaurante.
- (B) Mendigando lastimeramente una comida caliente, se desmayó.
 - (L) Mientras mendigaba lastimeramente una comida caliente, se desmayó.
 - (O) Mientras él mendigaba lastimeramente una comida caliente, se desmayó.

Probes: huérfano/orificio/millonaria/medicación

23. El obrero y la inquilina convinieron ayer el precio del arreglo de la casa. Esta mañana,
- (B) tras reparar hábilmente las tuberías del baño, empezó con la cocina.
 - (L) En cuanto reparó hábilmente las tuberías del baño, empezó con la cocina.
 - (O) En cuanto él reparó hábilmente las tuberías del baño, empezó con la cocina.

Probes: obrero/oceano/inquilina/aparición

DESCANSO (REST)

F Cuando el campesino estaba en el centro, vió a una viejita caerse en la calle. Corrió rápidamente hacia ella para ayudarla.

Probe: despacho

24. En la primera escena de la película se veía a una misionera y a un mercenario delante del ayuntamiento del pueblo.
- (B) Tras ametrallar de forma siniestra el edificio, mató a su víctima.
 - (L) Cuando ametralló de forma siniestra el edificio, mató a su víctima.
 - (O) Cuando él ametralló de forma siniestra el edificio, mató a su víctima.

Probes: mercenario/manuscrito/misionera/manzanilla

F Por las mañanas, el senador y su ayudante se reunen muy temprano. Les gusta tener todo bien preparado para cuando se inician las sesiones de la cámara.

Probe: melodía

25. El tranquilo vecino y su pequeña nieta iban en el coche marcha atrás y se dieron cuenta de que la bicicleta nueva estaba tirada en el camino.
- (B) Chillando fuertemente por el peligro, alarmó a los transeúntes.
 - (L) Mientras chillaba fuertemente por el peligro, alarmó a los transeúntes.
 - (O) Mientras ella chillaba fuertemente por el peligro, alarmó a los transeúntes.

Probes: nieta/nariz/vecino/bastón

F Aunque estaba a dieta, la amable señorita aceptó la invitación de cenar con un admirador en su restaurante favorito. Olvidándose de la dieta, comió demasiado.

Probe: arquitecto

26. El ingeniero de sonido y la estrella famosa estaban preparados para la grabación del disco.
- (B) Cantando el tema musical del film más popular, causó buena impresión a todos los presentes.
 - (L) Mientras cantaba el tema musical del film más popular, causó buena impresión a todos los presentes.
 - (O) Mientras ella cantaba el tema musical del film más popular, causó buena impresión a todos los presentes.

Probes: estrella/ensalada/ingeniero/ejercicio

F La operadora telefónica y su primo del pueblo se llaman todos los días. Cuando eran pequeños, jugaban mucho juntos.

Probe: palabra

F El refugiado desea descubrir el paradero de su madre, a quien dejó de ver cuando tenía 11 años de edad. Ha puesto anuncios en varios periódicos con la esperanza de que ella los vea.

Probe: pañuelo

27. El vendedor y la cocinera cambiaron impresiones sobre la subida de los precios.

- (B) Al cobrar la tremenda factura, pasó a la siguiente clienta.
- (L) Apenas cobró la tremenda factura, pasó a la siguiente clienta.
- (O) Apenas él cobró la tremenda factura, pasó a la siguiente clienta.

Probe: vendedor/desierto/cocinera/cualidad

28. La guitarrista y el bombero se aburrían cuando esperaban el tren en la estación.

- (B) Componiendo en su cuadernillo la letra de una canción, se imaginó una puesta de sol.
- (L) Mientras componía en su cuadernillo la letra de una canción, se imaginó una puesta de sol.
- (O) Mientras ella componía en su cuadernillo la letra de una canción, se imaginó una puesta de sol.

Probes: guitarrista/combinación/bombero/bacalao

F La alumna estaba preocupada porque tenía una cita después de la clase. Mientras miraba nerviosamente el reloj, le pareció que el profesor seguiría hablando toda la noche.

Probe: sangría

F Los socios del club deportivo se reúnen todos los fines de semana. En el verano juegan al fútbol en un parque de las afueras y en el invierno toman cerveza en el bar de la esquina.

Probe: archivo

29. La psicóloga y el prisionero hablaron del asunto que había causado la detención. El año pasado,

- (B) al robar cien mil pesetas de su compañía, dejó demasiadas pruebas en contra.
- (L) cuando robó cien mil pesetas de su compañía, dejó demasiadas pruebas en contra.
- (O) cuando él robó cien mil pesetas de su compañía, dejó demasiadas pruebas en contra.

Probes: prisionero/vecindario/psicóloga/zanahoria

2

F Ayer tuvo lugar, entre el periodista y una portavoz del ministerio, una conferencia acerca de la subida de los impuestos. Ahora se han anunciado los nuevos planes del gobierno.

Probe: botella

F El juez instructor ha hecho arrestar a una fugitiva involucrada en un importante caso de drogas. En las acusaciones formales, se incluye el lavado de dinero por dos millones de dólares.

Probe: taller

30. El tímido fotógrafo y la bella francesa trabajaron toda la mañana en el estudio. Bajo unas fuertes luces,

(B) posando provocativamente delante de la cámara, se sofocó mucho.

(L) mientras posaba provocativamente delante de la cámara, se sofocó mucho.

(O) mientras ella posaba provocativamente delante de la cámara, se sofocó mucho.

Probes: francesa/falsedad/fotógrafo/fregadero

F La joven actriz explicó al entrevistador que su vida no es sólo su carrera profesional. Quisiera encontrar al hombre de sus sueños, que aceptara compartir su medio artístico.

Probe: abogado

31. La dueña de la casa en venta y el músico interesado en comprarla regatearon por el precio durante varios días. Por fin,

(B) al vender la propiedad por la mitad del precio original, todavía hizo un buen negocio.

(L) cuando vendió la propiedad por la mitad del precio original, todavía hizo un buen negocio.

(O) cuando ella vendió la propiedad por la mitad del precio original, todavía hizo un buen negocio.

Probes: dueña/calma/músico/marmol

32. La contable y el taxista charlaron durante todo el viaje. Al final del trayecto,
- (B) frenando bruscamente ante el edificio, provocó un accidente.
 - (L) mientras frenaba bruscamente ante el edificio, provocó un accidente.
 - (O) mientras él frenaba bruscamente ante el edificio, provocó un accidente.

Probes: taxista/defecto/contable/pantalla/

F La terrorista y el empresario llevaban cinco días en el lugar del secuestro. Mientras ella dormía, él se escapó.

Probe: palmada

33. Por casualidad, el ejecutivo americano y la camarera del hotel se encontraron en la habitación a las diez de la mañana.
- (B) Limpiando con cuidado el polvo del escritorio, se disculpó.
 - (L) Mientras limpiaba con cuidado el polvo del escritorio, se disculpó.
 - (O) Mientras ella limpiaba con cuidado el polvo del escritorio, se disculpó.

Probes: camarera/película/executivo/azucarero

F El jugador de béisbol y su orgullosa madre se escriben casi diariamente. Al recibir cada noticia, ella cuenta a todo el mundo que él se está superando.

Probe: programa

34. El banquero y su secretaria iban a celebrar el éxito de la gestión empresarial con una gran cena.
- (B) Al invitar generosamente a otros empleados de confianza, se quedó contento.
 - (L) Dado que invitó generosamente a otros empleados de confianza, se quedó contento.
 - (O) Dado que él invitó generosamente a otros empleados de confianza, se quedó contento.

Probes: banquero/pedestal/secretaria/servilleta

35. La homicida y el magistrado se encararon delante del tribunal de apelación.
- (B) Al condenar con vehemencia el horrible crimen, provocó una reacción pública.
 - (L) Cuando condenó con vehemencia el horrible crimen, provocó una reacción pública.
 - (O) Cuando él condenó con vehemencia el horrible crimen, provocó una reacción pública.

Probes: magistrado/murciélago/homicida/angustia

F El albañil y la florista se quedaron atrapados en el viejo ascensor. Desatornillando la ventanilla de la parte superior, consiguió alcanzar la palanca.

Probe: nimiedad

F El policía de tráfico y el camionero no estaban de acuerdo sobre la infracción cometida. Después de requerir la documentación, amenazó con una multa.

Probe: acueducto

36. Al terminar la cena, el machista doctor y su resignada esposa se quedaron con un montón de platos sucios.
- (B) Fregando uno por uno todos los platos, se sintió muy deprimida.
 - (L) Mientras fregaba uno por uno todos los platos, se sintió muy deprimida.
 - (O) Mientras ella fregaba uno por uno todos los platos, se sintió muy deprimida.

Probes: doctor/débate/esposa/acción

F Los dos últimos finalistas en el concurso eran un muchacho y una chica. Aunque lo ganó ella, se sentía triste y abandonada, porque no habían venido sus padres.

Probe: muchacha

37. La estudiante desganada y el futbolista glotón compartieron una mesa en la cafetería del aeropuerto.

- (B) Tras engullir un plato de lentejas con arroz, se bebío dos vasos de cerveza.
- (L) En cuanto engulló un plato de lentejas con arroz, se bebío dos vasos de cerveza.
- (O) En cuanto él engulló un plato de lentejas con arroz, se bebío dos vasos de cerveza.

Probes: futbolista/fundamento/estudiante/habitación

F En la fiesta de cumpleaños el payaso se acercó a un tímido niño. Se puso a entretenerlo haciendo muecas, y rieron los dos por el chiste.

Probe: monasterio

F La profesora de arte se ha enterado de que un alumno suyo se ha enamorado de ella. Como es bastante simpático, ella le encuentra atractivo.

Probe: bebida

38. La gitana y el cliente se sentaron delante de la bola de cristal.

- (B) Prediciendo un futuro próspero y feliz, sintió un leve ardor en las mejillas.
- (L) Mientras predecía un futuro próspero y feliz, sintió un leve ardor en las mejillas.
- (O) Mientras ella predecía un futuro próspero y feliz, sintió un leve ardor en las mejillas.

Probes: gitana/jugada/cliente/corazón

F La escultora y el coleccionista contemplaban la figura de mármol en el estudio. Mientras ella daba los últimos retoques, él se deshacía en elogios.

Probe: diagrama

39. El cantaor y la aficionada se reconocieron antes del concierto. En el primer numero,

- (B) al interpretar unas magníficas bulerías, obtuvo una gran ovación.
- (L) cuando interpretó unas magníficas bulerías, obtuvo una gran ovación.
- (O) cuando él interpretó unas magníficas bulerías, obtuvo una gran ovación.

Probes: cantaor/delirio/aficionada/emergencia

40. En el cuento, el valiente caballero y la princesa desmayada llegaron a la oscura casa encantada.

- (B) Desafiando a los fantasmas con entusiasmo, gozó de la experiencia.
- (L) Mientras desafiaba a los fantasmas con entusiasmo, gozó de la experiencia.
- (O) Mientras él desafiaba a los fantasmas con entusiasmo, gozó de la experiencia.

Probes: caballero/conflicto/princesa/barbilla

41. El flamante diestro y la impresionada duquesa se conocieron antes de empezar la corrida.

- (B) Al matar ceremoniosamente el primer toro, echó un vistazo al tendido.
- (L) Cuando mató ceremoniosamente el primer toro, echó un vistazo al tendido.
- (O) Cuando él mató ceremoniosamente el primer toro, echó un vistazo al tendido.

Probes: diestro/paraíso/duquesa/palanca

F El hombre de negocios entró en la tienda para comprar una corbata. Como

42. El médico de urgencia y la conductora gravemente herida estaban en la sala de cuidados intensivos.
- (B) Al fallecer al cabo de una hora, dejó a su familia desamparada.
 - (L) Cuando falleció al cabo de una hora, dejó a su familia desamparada.
 - (O) Cuando ella falleció al cabo de una hora, dejó a su familia desamparada.

Probes: conductora/campanilla/médico/millón

43. Después del paseo en el parque, el mayordomo sosegado y la colegiala maleducada regresaron a casa.
- (B) Al blasfemar sin mas motivo, molestó a la familia.
 - (L) Cuando blasfemo sin mas motivo, molestó a la familia.
 - (O) Cuando ella blasfemo sin mas motivo, molestó a la familia.

Probes: mayordomo/melodrama/colegiala/cabellera

F Un policía y un rebelde murieron ayer en Colombia durante un ataque guerrillero. Murieron cuando los insurgentes atacaron a una patrulla en el sur del país.

Probe: sinceridad

44. El peluquero y la modelo contemplaron la nueva imagen en el espejo.
- (B) Tras cortar cuidadosamente el flequillo, quedó satisfecho con su trabajo.
 - (L) Así que cortó cuidadosamente el flequillo, quedó satisfecho con su trabajo.
 - (O) Así que él cortó cuidadosamente el flequillo, quedó satisfecho con su trabajo.

Probes: peluquero/crucifijo/modelo/nación

45. El despreocupado motorista y la tímida pasajera se acercaron a la salida de la ciudad.
- (B) Acelerando la marcha rápidamente, sobrepasó la limitación de velocidad.
 - (L) Mientras aceleraba la marcha rápidamente, sobrepasó la limitación de velocidad.
 - (O) Mientras él aceleraba la marcha rápidamente, sobrepasó la limitación de velocidad.

Probes: motorista/micrófono/pasajera/blandura

F La anfitriona y el dignatario visitante se encontraron solos a la hora de la cena. Sirviendo una suntuosa comida de mariscos con salsa verde, se superó.

Probe: teclado

46. El detective y la ladrona hablaron del incidente que ocurrió ayer en el centro.
- (B) Tras confesar con gran sinceridad, evitó ser arrestada.
 - (L) Dado que confesó con gran sinceridad, evitó ser arrestada.
 - (O) Dado que ella confesó con gran sinceridad, evitó ser arrestada.

Probes: ladrona/lejanía/detective/doctorado

47. El heredero griego y la dependienta de la joyería admiraron el carísimo anillo de diamantes.
- (B) Tras gastar una pequeña fortuna en el anillo, siguió haciendo las compras.
 - (L) Apenas gastó una pequeña fortuna en el anillo, siguió haciendo las compras.
 - (O) Apenas él gastó una pequeña fortuna en el anillo, siguió haciendo las compras.

Probes: heredero/elemento/dependienta/diapositiva

48. El barman y la cantante se sonrieron a través de la barra.
- (B) Al servir el rico refresco, le presentó la cuenta.
 - (L) En cuanto sirvió el rico refresco, le presentó la cuenta.
 - (O) En cuanto él sirvió el rico refresco, le presentó la cuenta.

Probes: barman/bramido/cantante/polución

F El abogado y su novia han conseguido realizar su sueño de viajar por el Caribe. Antes de decidirse, consultaron una docena de agencias de turismo.

Probe: concha

EL EXPERIMENTO HA TERMINADO. MUCHAS GRACIAS POR TU COLABORACION.

Appendix C: Materials, Experiment 3

PRACTICE:

- F At the start of the year, the student teacher working in the second grade classroom underestimated the children's reasoning capacities.
Probe: clock
- F Most nights the paramedics with the emergency medical service are so busy they barely get time for their dinner break.
Probe: telephone
- F With good cause, the soloist in the nostalgia band performing at a downtown nightclub prided himself on an extensive repertoire of oldies.
Probe: soloist
- F Annoyingly, the counterperson at the corner donut shop always fills the coffee containers so high that coffee leaks out in the bag.
Probe: umbrella
- F In small claims court, the attorney, who was more experienced and familiar with tax matters, acquainted himself thoroughly with the facts of the case.
Probe: attorney

EXPERIMENT

- F Sadly, the acrobat from the world famous Canadian avante-garde circus hurt himself during yesterday morning's rehearsal.
Probe: apricot
- F Despite the rain, the weatherman on the network television evening newscast predicted clear skies for the rest of the week.
Probe: wonderland

- E1 After the game, the pitcher/catcher with the unfortunate and apparently persistent drinking problem injured himself/a man in a barroom brawl.
Probe: pension
- F The family who moved into the Smiths' old house across the street invited all the neighbors to a housewarming party next weekend.
Probe: newspaper
- E2 At the uptown beauty salon, the stylist/hairdresser at the last work station near the back of the shop admired herself/the girl in the mirror in front of the chair.
Probe: silence
- F Twice a week the chiropractor manipulates the old man's spine to help relieve the everpresent pain of arthritis.
Probe: metal
- E3 Over the years, the owner/manager of the shamefully run down senior citizens residence allowed himself/the aides leeway in observance of the health codes.
Probe: ocean
- E4 Politely, the secretary/assistant in the university buildings and grounds department introduced herself/the boss to the temporary word processor sent over by personnel.
Probe: seminary
- F Most every Friday the supervisor of the power plant night crew buys all the workers breakfast at the local diner.
Probe: supervisor
- E5 Annoyingly, the technician/representative from the customer service department at the computer company contradicted himself/the boss during a discussion of hardware installation.
Probe: temptation
- F Training at the gym four hours a day, the Olympic gymnast and the Eastern European trainer impressed everyone with their dedication and focus.
Probe: dictionary
- F As soon as the customer entered the boutique, the shopkeeper greeted her and offered to help with her selections.
Probe: customer

- E6 As flight time approached, the pilot/attendant on the crowded twelve-hour trip to Hawaii prepared himself/the crew for an exhausting workshift.
Probe: parrot
- F To the degree possible the interior designer accepts only clients whose tastes and personalities are compatible with her own.
Probe: suitcase
- F Last semester the chairman of the sociology department hosted a year-end party for faculty and students in the department.
Probe: chairman
- E7 Despite the shabby environment, the orphan/youngster from the humblest household in the poor rural town dressed herself/the doll with great attention to detail.
Probe: option
- 8 Night after night, the barman/waiter in the lounge at the five-star hotel tells himself/someone that rich people are terrible tippers.
Probe: balsam
- F At the awards show, the leading actress from that movie about the alien invaders ingratiated herself with the charmed audience.
Probe: audience
- E9 Illogically, the dentist/pediatrician at the government-sponsored cost-free family center blamed himself/the nurse for the nervous condition of many of the children.
Probe: decking
- F Once in a while the District Attorney has mixed feelings about winning a criminal case because he sympathizes with the defendant.
Probe: octopus
- E10 Periodically, the guard/security officer at the semi-deserted and temporarily inoperative nuclear power plant reminds himself/the staff of the possibility of prowlers. Probe: garb
- F Next week the author of the recent best-selling novel will be reading selections from her work at a local bookstore.
Probe: author

- E11 Amongst soccer fans it's known that the goalie/captain from this year's regional champion amateur league identifies himself/the coach with a boyhood role model.
Probe: galley
- E12 At the audition, the drummer/guitarist with experience in an enormously popular local group outshone himself/the rest with a really impressive solo routine.
Probe: dungeon
- F After ten years at the same store, the butcher at the local meatmarket knows the preferences of many of the regular customers.
Probe: butcher
- E13 On a sunny afternoon, the accountant/CPA on an unexpected visit to New York City photographed herself/a guide in front of the United Nations Headquarters.
Probe: assignment
- F The systems support personnel at the electronics manufacturing firm complimented each other on a difficult job well done.
Probe: personnel
- E14 Slowly, the motorist/passenger at the tumultous scene of the nightmarish crash calmed herself/the child with peaceful images of her family at home.
Probe: medicine
- E15 Every Monday morning, the banker/treasurer from one of the most influential institutions in the city apprises himself/the clerks of the agenda for the entire week.
Probe: bangle
- F The shoemaker at the neighborhood repair shop hopes his oldest son will take over the business when he retires.
Probe: shoemaker
- E16 As usual, the hustler/gang leader on the downtown street in the afternoon rush hour hid himself/the thieves from the passing detectives.
Probe: hunger
- F From the beginning, the publisher of the ground-breaking arts magazine encouraged his reporters to be passionate about everything they wrote.
Probe: publisher

- E17 After lunch, the adolescent/teenager in the pediatric recovery ward of the hospital entertained herself/the nurse with a comic imitation of the doctor.
Probe: ammunition
- E18 Early every morning, the widow/old lady in the back pew of the quiet church prays for herself/the priest as well as for everyone in her family.
Probe: winter
- F According to the story, the actor named in a scandal about babyselling brought suit against the columnist for libel.
Probe: broccoli
- E19 Skillfully, the fireman/policeman with the specially-designed heavy-duty gas mask protected himself/the dog from the asphyxiating fumes.
Probe: finance
- F The manager at the neighborhood movie theater got into an argument with a teenager who tried to sneak ahead of the people on the long line.
Probe: manager
- F The construction workers on the Brooklyn Bridge are always joking with each other about all the gullible types they've sold it to.
Probe: message
- E20 Absentmindedly, the bachelor/playboy from one of the richest families in the city checked himself/the maid out in a mirror at the country club.
Probe: backspin
- F By nine o'clock, the night school teacher in the adult basic education program was just as anxious as her students were to go home.
Probe: calendar
- F With skill and diligence, the carpenter and his helper finished building the garage in just two and a half days.
Probe: carpenter
- E21 In a hurry, the waitress/cleaning lady at the new place over by the community recreation center knocked herself/a child in the shin with a washbucket.
Probe: wastage

- E22 In the last scene, the ruffian/hoodlum in the movie about street life in urban Brazil gets himself/the girl in trouble with the local authorities.
Probe: raffia
- E23 Cautiously, the surgeon/psychiatrist at the most prestigious research center in the state convinced himself/the nun of the necessity for the dangerous procedure.
Probe: sermon
- F By the end of the work-day, the receptionist at the front desk of the busy law firm satisfied herself that all the messages had been delivered.
Probe: receptionist
- E24 In time, the pharmacist/salesclerk at the twenty-four hour convenience store finally adjusted herself/the staff to the all-night work schedule.
Probe: phosphorous
- E25 At the carnival, the gypsy/palmreader from the colorful caravan that arrived just yesterday afternoon amazed herself/the crowd with uncanny insights into her customers' lives.
Probe: genie
- F When the traffic was blocked due to an accident, the busdriver, who's been driving the same route for years, took a detour around the worst blocks.
Probe: busdriver
- E26 Wisely, the foreigner/tourist from northern Canada in the tropics for the first time familiarized herself/the kids with the relevant health and safety precautions.
Probe: furniture
- E27 Fairly convincingly, the host/announcer on the popular call-in program about single life portrayed herself/the guest as an expert on the subject.
Probe: hole
- F At last night's meeting, the high school principal addressed the members of the PTA about the cuts in next year's operating budget.
Probe: melody
- F From midnight to five, the toll booth attendant at the entrance to the Midtown Tunnel listens to her favorite talk radio program.
Probe: attendant

- E28 With time and practice, the swimmer/trainer on vacation on Long Island for most of the summer trained herself/ the dog better than could have been expected.
Probe: scissors
- F Months before the holiday, the Christmas tree vendors who set up stands all over the city make arrangements to buy their stock.
Probe: vendors
- E29 With a sharp pencil, the tutor/babysitter from the highly respectable British employment agency wrote herself/the kids a note about plans for next week.
Probe: tartar
- F When he first got sick, the artist consulted a nutritionist who recommended massive doses of vitamins and minerals.
Probe: submarine
- F The headhunter at the high-powered Washington, D.C. agency checked out each of the candidate's references thoroughly.
Probe: headhunter
- E30 Over the long rainy weekend the singer/writer with the vacation house in one of the quietest Fire Island communities involved herself/the guests in indoor activities like baking cookies.
Probe: symbol
- F According to the book reviews, a previously unpublished biographer has written the definitive book on the tragic life of a famous film star.
Probe: museum
- E31 Despite the highest of hopes, the boxer/wrestler from the exotic, remote town in the Amazon Jungle disappointed himself/the fans during the first round of the fight. Probe: bottle
- F During the lunch hour rush, the bank teller at the last window disappointed everyone on line by closing for his break.
Probe: teller
- E32 After dinner, the dancer/ballerina with the San Francisco company in Paris for the first time congratulated herself/the chef on a job well done.
Probe: danger

- F Because her work is a strain on the eyes, the seamstress is cautious about caring for them and visits the ophthalmologist regularly.
Probe: albatross
- F The astrologist, who has many media stars as clients, advises them on everything from their love life to tax planning.
Probe: peace

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