Competitive information sources in referential ambiguity resolution

ARMANDA COSTA
ISABEL HUB FARIA
GABRIELA MATOS
Departamento de Linguística, Faculdade de Letras, Universidade de Lisboa, Portugal

Constructions in which one must deal with ambiguity have been an interesting domain to study some aspects of processing. Some questions, such as the following ones, have been relevant in research into language processing:

a) what are the information sources that compete to solve the ambiguity?
b) what are the processing strategies available to the subject to solve the ambiguity?
c) what are the strongest linguistic and non-linguistic cues to guide parsing and interpretation?

It is worth considering the specific syntactic properties of each language to conduct well controlled processing experiments in order to discover the linguistic and cognitive processes involved in the computation of specific structures. In this paper we will deal with subject coreference processing in EP in coordinate structures.

COREFERENCE PROCESSING IN EP – COORDINATE STRUCTURES

European Portuguese (EP), being a null subject language (see Mateus, Brito, Duarte & Faria 1989), allows for the production of a particular type of ambiguity concerning the assignment of coreference in sentence coordination, when the subject of the second coordinate clause depends referentially on a previous NP in the first conjunct. While, in the second conjunct, a null subject is systematically coreferent with the subject of the first clause, an overt pronoun may corefer with any previous NP, though, in some circumstances, it tends to be referentially disjunct from the subject of the first subordinate clause.

(1) a. A Helena$_i$ viu a Maria$_j$ mas [–]$_i$ não a cumprimentou.
     Helen saw Mary but did not greet her.
   b. A Helena$_i$ viu a Maria$_j$ mas ela$_{?i/j}$ não a cumprimentou.
     Helen saw Mary but she did not greet her

These facts, which recall some earlier work on subordinate clauses in theoretical syntax (see, for instance, Chomsky 1981, Montalbetti 1986), offer interesting conditions for the study of language processing: different linking strategies seem to provide the bases for different interpretations when the referred subject is either an overt pronoun or an empty category, in spite of the pronominal status of both categories.

This study was preceded by previous works on syntactic processing of EP (Costa 1991, Costa et al. 1994, Costa and Faria 1996). Costa and Faria 96, focusing on the effects on chain computation in coordinate structures caused by (i) syntactic distance, (ii) locality constraints,

(iii) conceptual connectivity, have shown that parsing was guided by the structural principle of c-command over locality constraints.

SYNTACTIC BACKGROUND

The processing study was constructed taking into account hypotheses about:

(i) the status of Null Subjects in coordination structures;

(ii) the structural properties of coordination;

(iii) the correlation between conjoint or disjoint reference and the covert vs. overt nature of pronominal subjects.

It is possible to assume that the null subject in the second conjunct is either a trace left by Across-the-Board Movement or a pronominal like the one which occurs in root clauses in Null Subject Languages (Matos 91). However, the examples in (2), exhibiting island contexts, show that the pronominal hypothesis cannot be discarded:

(2) a.   A Helena$_i$ viu a Maria e lamento que [-]$_i$ não a cumprimentasse
    Helena saw Maria and (I) regret that (she) did not greet her

   b.   A Helena$_i$ viu a Maria mas ouvi o boato de que [-]$_i$ não a cumprimentou
    Helena saw Maria but (I) heard the rumour that (she) did not greet her

To account for the assignment of coreference to the null subject of the second clause, we assume that this structural condition of c-command constrains its interpretation. Based on earlier work presented in Kayne 94 and Matos 94 & 96 on the syntactic structure of coordination, we accept that:

– Coordination structures are projections of a Conjunction head (Conj) of which the first conjunct is a specifier, and the second its complement;

– Conj is a head categorically sub-specified which inherits the categorial features from its specifier.

In this structural condition the Subject in the first clause c-commands the null subject of the second one:

(3) [ConjP=IP [IP1 [NP a Helena]$_i$ [IP VP]] [ConjP=IP [Conj mas] [IP2 ... [pro]$_i$ IP]]]

Nevertheless, the syntactic principles of Binding Theory do not seem to be able to explain the contrast in the assignment of coreference to the overt vs. null subject pronominals in these structures: the principle B only requires the pronominal to be free in its Minimal Functional Complex. So, we claim that a processing strategy is at work. Considering the proposals by Chomsky 1981, we will suggest that this strategy may be related to the Avoid Pronoun Principle, which displays particular effects in Null Subject Languages, regulating the contexts of occurrence of null vs. overt subject pronominals.

HYPOTHESIS

Language processing general hypothesis:

– the on-line comprehension process is driven by multiple linguistic and non-linguistic information sources that compete interactively;

– structural conditions strongly determine the way the parsing is done;

– it is possible to identify the strongest cues that guide the processing.

Coreference assignment has been a delimited area of research in syntactic and semantic processing. From the empirical and theoretical work available (see, for instances, McKee & McDaniel 1993, MacDonald & MacWhinney 1990, Nicol & Swinney 1989) some results have emerged that are worthy of note.

In the particular case of coordinate structures, we can hypothesize that coreference assignment may be driven by:

– syntactic information: the highest structural position occupied by the (SU)bject of the first clause is the best candidate to bind the empty category (Matos 1991, 1996);

– semantic information: the thematic grid of the predicate facilitates or inhibits the option for one antecedent among others;

– pragmatic constraints, which can interfere on activation levels of the previous NPs;

– the number of possible antecedents, which overload the processing system.

METHOD

Sixty experimental sentences were designed with two versions, each corresponding to two experimental conditions:

A) null subject in the second coordinate clause;
B) overt pronominal subject in the second coordinate clause.

Two groups of 30 sentences each assembled 5 subgroups, each subgroup corresponding to the experimental variables:

Controlled variables:

Coordinate	vs	Subordinate sentences
Overt pronoun	vs	Empty category ;
Transitive	vs	Ditransitive Verbs ;
Verb theta-grid	(Agent, Instrumental, Experiencer, Recipient, Theme, Location)	

Subjects: Forty volunteer students, from the University of Lisbon, participated in this study.

Procedure: In a naturalistic reading task, the subjects were asked to read sentences one by one at their own pace and to answer simple comprehension questions by marking one of the possible answers, in order to find a preferential interpretation.

Materials: A multiple choice sentence comprehension test was used. It consisted of 60 sentences randomly assembled.

Ex: A Maria apresentou a Ana à Susana mas ela não lhe prestou grande atenção
      Mary introduced Ann to Susan but she did not pay any attention to her

Quem não lhe prestou grande atenção?

Who did not pay any attention to her?

a Maria ❑   a Ana ❑   a Susana ❑

Experimental setting

Coordinate sentences:

A – NP1 [Agent/Experiencer] Verb NP2 [Theme, +animate]
B – NP1 [Agent/Experiencer] Verb NP2 [Theme, +anim] NP3 [Loc, +anim]
C – NP1 [Agent/Experiencer] Verb NP2 [Instrumental/Theme, -anim]
D – NP1 [Agent] Verb NP2 [Instrumental/Theme, -anim] NP3 [Loc, +anim]

Subordinate sentences:

E –   NP1 [Agent/Experiencer/Recipient] Verb NP2 [Theme, +anim]

RESULTS

Mean choices for the Antecedent of S2-Subject (N=40)

		coordinate sentences				subordinate sentences
	Antecedent	A	B	C	D	E
conditionA)	1 – NP1 (SU)	36.2	33.3	29.2	24.3	33
S2: Null-SU	2 – NP2 (O)	3.7	3.5	10.7	11.7	6.8
	3 – NP3 (IO)	—-	3.2	—-	3.8	—-
condition B)	1 – NP1 (SU)	7.8	6.3	12.2	6.5	8.2
S2:	2 – NP2 (O)	32.2	17.8	27.8	23.2	31.7
SU Overt Pron	3 – NP3 (IO)	—-	15.8	—-	10.3	—-

DISCUSSION

1. Coordinate structures act like adverbial ones with respect to the identification of null subjects:

   (i) The binder of the Null Subject in the second clause is NP1;
   (ii) The preferential binder of the Overt Pronominal Subject in the second clause is NP2 or NP3;

These data show that the processing of both types of these complex sentences triggers operations that connect structurally and informationally independent units through intersentential grammatical devices.

2. In coordinate structures, although NP1 is the preferential binder of the null subject in the second clause, its prominence as identifier decreases when compared with other potential identifiers according to the:

    (i) overload of the cognitive processing system that deals with multiple NPs on the same level of activation in memory;
    (ii) compatibility of the thematic role of NP2 with the external theta-role assigned by the verb in the second clause;
    (iii) existence of semantic properties in VP that prevents its external argument acting as an appropriate identifier of the null subject in the second clause.

3. In overt pronominal subject condition, the pronominal is preferentially disjunct from NP1.
    NP2 and NP3 are equally selected as antecedents of the pronoun. This can be explained by:

    (i) the propositional content that pragmatically biases the interpretation;
    (ii) the syntactic constraints on coreference involving overt pronominals: since neither of the potential antecedents c-commands the overt pronoun, their difference concerning their hierarchical position is no longer relevant.

CONCLUSION

In the conditions presented, the assignment of reference to the null subject and overt pronominal subject follows a strategy of economy:

(i) whenever the participant in this experiment finds an empty category as Subject of the second coordinate clause, he/she immediately chooses as its antecedent the most prominent NP, regarding either its structural position (c-command) or its memory activation level;
(ii) whenever the participant finds an overt pronominal as Subject of the second conjunct, he/she preferentially takes it as a cue to trigger the search for an antecedent that does not c-command it. This strategy recalls what has been called, in previous frameworks, the *Avoid-Pronoun-Principle* (Chomsky 1981, Brito 91), a discourse condition based on grammatical principles at the sentence level.

Our results show that, underlying the preferential interpretations, there exist well learnt strategies guided by grammatical knowledge. These strategies are aimed at decreasing the load on the processing system. So, we can assume that what has been called the *Avoid-Pronoun-Principle* derives from the convergence of grammatical and processing sources.

REFERENCES

Brito, A. M. 1991. Ligação, co-referência e o princípio evitar o pronome. In *Actas do Encontro de Homenagem a Óscar Lopes*. Lisboa, Associação Portuguesa de Linguística.

Chomsky, N. 1981. *Lectures on government and binding*. Dordrecht, Foris Publications.

Costa, A. 1991 *Leitura: compreensão e processamento sintáctico*. Tese de mestrado. Faculdade de Letras da Universidade de Lisboa.

Costa, A.; Faria, I. H. 1996. Stratégies de parsing et coûts de traîtement: structures syntaxiques avec constituants déplacés en Portugais European. AILA 96, 11ᵉ Congrès mondial de linguistique appliquée. Jyvaskyla.

Costa, A.; Faria I.; Freitas, M. J.; Figueira, M. L.; Nicolau, H. B. 1994. Processing problematic syntactic contexts while reading aloud. 4th ISAPL International Congress. Bologna-Cesena.

Johannessen, J. 1996. Partial agreement and coordination. *Linguistic Inquiry*, 27, 661-676.

Kayne, Richards S. 1994. *The antisymmetry of syntax*. Cambridge: The MIT Press.

Mckee, C.; Nicol, J.; McDaniel, D. 1993. Children's application of binding during sentence processing. *Language and Cognitive Processes, 8(3)*, 265-290.

Macdonald M. C.; MacWhinney, B. 1990. Measuring inhibition and facilitation from pronouns. *Journal of Memory and Language, 29,* 469-492.

Mateus, M. H. M.; Brito, A. M.; Duarte, I.; Faria, I. H. 1989. *Gramática da Língua Portuguesa*. Lisboa, Caminho. [2ª ed.]

Matos, G. 1996. ATV clitic placement in European Portuguese: a comparative approach. *Xth Conference on Romance Languages*. Utrecht.

Matos, G. 1994. Estruturas binárias e monocêntricas em sintaxe: algumas observações sobre a coordenação de projecções máximas. *Actas do X Encontro da APL:* Évora.

Matos, Gabriela 1991. Coordenação, sujeito nulo e co-referência. In *Encontro de Homenagem a Óscar Lopes*. Lisboa: Associação Portuguesa de Linguística.

Montalbetti, M. 1986. How pro is it? In Jaeggli, O. & C. Silva-Corvalan eds. *Studies in Romance Linguistics*. Foris Publications: Dordrecht.

Nicol, J.; Swinney, D. 1989. The role of structure in coreference assignment during sentence comprehension. *Journal of Psycholinguistic Research, 18(1)*, 5-19.