

## **SQUIB: CO-REFERENCE AND ADULT LANGUAGE COMPREHENSION**

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### **ABSTRACT**

There exists a large, rich and varied literature on the processing of pronouns and other anaphoric forms in the adult language comprehension literature. Rather than trying to review it all, an impossible task in a small space, certain findings will be discussed that are particularly informative either because they place strong constraints on the processing of co-reference and more generally on anaphora or because they pose problems or challenges for an adequate theory of anaphora processing.

**KEY WORDS:** processing of pronouns, co-reference, anaphora

How does the grammar contribute to the processing of co-reference? Beyond doubt, the likelihood of a pronoun or other anaphor taking an antecedent depends on the grammatical role and the position of the antecedent. Section 1 will focus on the nature of these constraints, and raise questions about why they should hold. Section 2 will address constraints on the form of the referring devices speakers use, and their underlying cause. Related issues concerning cross-language differences in the structures speakers exploit for co-reference will be taken up in Section 3. Section 4 turns to the role of grammatical features in processing pronouns. Section 5 concludes.

### **1. POSITION MATTERS**

#### **1.1. Locality**

Binding Theory (Chomsky, 1981) captures one important way in which the position of antecedent and pronominal matters. It requires a pronoun to be free within its local domain, and it requires reflexives and reciprocals to be bound in their local domain. In a sentence like (1), the pronoun (bolded for the reader's convenience) cannot co-refer with *the fireman* according to the constraint requiring pronouns to be free in their local domain. In (2) the reflexive (also bolded for convenience) must be bound in its local domain.

Nicol (1988) conducted experiments using semantic priming to test whether ungrammatical antecedents, the fireman in (1) or the landlord in (2) are activated when the pronominal is processed. She found that they were not: only the Binding Theory compatible antecedents primed words semantically related to them when those words were presented immediately at the offset of the pronominal.

(1) The landlord told the janitor that the fireman with the gas mask would protect **him** if it became necessary.

(2) The landlord told the janitor that the fireman with the gas mask would protect **himself** if it became necessary.

The results thus provided striking support for Binding Theory. See Sturt (2003) for compatible evidence using eye movement recording during reading. His study showed no interference effect from feature-appropriate phrases appearing in the wrong syntactic position to be an antecedent, at least in early stages of processing.

## 1.2. Position of antecedent

Carminati (2005) investigated the processing of overt and null pronominals in Italian. She found that null pronominals ('pro') strongly prefer antecedents in the pre-verbal subject position (Spec, IP). Not only is there a preference for a subject antecedent for pro in ambiguous examples, but also unambiguous object antecedent examples take longer to process than unambiguous subject antecedent examples. For example, self-paced reading times for the final clause of subject antecedent sentences (3b) were longer than for object antecedent sentences (3a).

(3) a. Quando Lucia ha telefonato a Marco, era appena tornata da Londra.  
'When Lucia has telephoned to Marco, pro was just come back (fem) from London.'  
When Lucia telephoned Marco, she had just come back from London.

b. Quando Lucia ha telefonato a Marco, era appena tornato da Londra.  
'When Lucia has telephoned to Marco, pro was just come back (msc) from London.'  
When Lucia telephoned Marco, he had just come back from London.

Carminati (2005) proposed that pro takes a highly accessible antecedent, defined in Carminati (2002) as an antecedent in pre-verbal subject position (Spec IP), dubbing the hypothesis the "Position of Antecedent" hypothesis. Antecedent preferences defined in terms of position and grammatical function have also been observed in English (e.g., Terken and Hirschberg, 1994, among many others). Frana (2008) further developed this approach by manipulating the topicality of the antecedent in Italian discourses like (4). Specifically, resuming an earlier discourse topic through reference by a clitic, as in (4a), indicates that Mrs. Rossi continues to be prominent, e.g., the discourse topic. By contrast, in (4b) where Mrs Rossi is resumed with a proper name reference, the choice of referring form does not imply that Mrs. Rossi is prominent. The fragments in (4a,b) where each continued with either a pro or an overt pronoun continuation (4c,d). In a written questionnaire, participants were asked to read discourses like (4) and answer questions about them that revealed the choice of antecedent for the pronominal (pro or overt pronoun) subject of the main clause.

(4) Context: La signora Rossi è una persona moto maleducata che non merita alcun riguard.  
'Mrs. Rossi is a very rude person that doesn't deserve any regard.'

a. clitic: Quando Maria **la** incontra per strada, ...  
'When Maria her-sees in the street, ...'

b. full DP: Quando Maria incontra **la signora Rossi** per strada, ...  
'When Maria sees Mrs. Rossi in the street, ...'

Continuation;

c. ... **pro** fa sempre finta di non vederla.  
'..pro pretends not to see her.'

d. ... **Lei** fa sempre finta di non vederla.  
'..She pretends not to see her.'

The choice of SpecIP (Maria) antecedents was lower in the clitic conditions (4a) than in full DP conditions (4b) especially when the continuation contained pro (4c). In other words, when the clitic indicated that some entity other than the one mentioned in SpecIP was topical, participants tended to choose the topical antecedent (only 35% SpecIP antecedents for pro; 65% topic choices). But with a full DP referring back to Mrs. Rossi, the majority of responses (71%) indicated the SpecIP phrase (Maria) was chosen as antecedent for pro. The results thus suggest that in general the reason why the Position of Antecedent hypothesis holds may be because the highest SpecIP is the likely position where a discourse topic is mentioned. When the discourse topic is mentioned but not in this position, then SpecIP is no longer favored as the antecedent.

Available studies of Asian languages such as Korean suggest that topic may play a comparable role as in Italian in defining preferred antecedents for pro, even though the grammatical structure may be different. However, perhaps grammatical features play a less important role in such languages than in languages which contain SV agreement (Kwon and Sturt, to appear).

### 1.3. Parallelism

Coherence theory (Kehler, 2002) postulates that there are a small number of discourse coherence relations that are commonly used to structure discourse, e.g., causal relations (*because, as a result*), contiguity or 'occasion' relations (*and then*), and resemblance or 'parallel' relations (involving similarity or contrast), as illustrated in (5). When resemblance relations link clauses together, then pronouns are preferentially assigned an antecedent in the same syntactic position as the pronoun, as in (6a). (6a) contrasts with (6b) which expresses a result relation rather than a parallel/resemblance relation.

- (5) a. Bill went to the movies, and Hillary went to the store. (Parallel)  
b. Bill went to the movies, and (then) he came home. (Occasion)  
c. Bill went to the movies, and (as a result) Hillary got upset. (Result)

- (6) a. Samuel threatened Justin with a knife and Erin blindfolded him with a scarf. (Parallel)  
b. Samuel threatened Justin with a knife and Erin stopped him with pepper spray. (Result)

For this approach to anaphora, see in particular Kehler et al. (2008).

## 2. FORM OF REFERRING EXPRESSION

### 2.1. Accessibility and definiteness hierarchies

Many linguists have argued that the different devices that could be used to refer to an entity are not equivalent. For example, Givón's (1983) hierarchy is given below. The idea is that a zero anaphor suffices for highly accessible antecedents, but less accessible antecedents may require moving further down the hierarchy.

Givón's (1983,88) scale of topic accessibility: zero anaphor > unstressed pronoun > stressed pronoun > definite noun > referential indefinite noun

Chafe (1987) argued that if an entity is already active in discourse, the concepts expressing that entity are verbalized in an attenuated manner, for instance by pronominalising.

The basic notion that which referring device is used matters is already implicit in the discussion of the position of antecedent hypothesis in Section 1.2, which applies to the null pronominal in Italian not to overt pronominals. The insight also offers some insight into why it is so odd to refer back to a highly accessible discourse referent with a name in discourses like (7).

(7) Jason walked in. Jason sat down.

This so-called 'Repeated Name Penalty' has been studied extensively by Gordon and colleagues (e.g., Gordon, et al., 1999 and references therein).

### 2.2. Choice of referring device structures discourse

Vonk and colleagues (Vonk, Hustinx and Simons, 1992) argued that choosing a 'larger' or more explicit referring device (pro < pronoun < name < description...) than is needed indicates a break in the discourse, e.g., the beginning of a new episode. They provide considerable support for this view from intuitions, e.g., the oddness of (8a) in the face of the relative acceptability of (8b), as well as from production experiments that found more non-pronominal continuations when there was a thematic shift in discourse than when there was not.

(8)a. Sally Jones got up early this morning.

She wanted to clean the house.

Her parents were coming to visit her.

She was looking forward to seeing them.

She weighs 80 kilograms.

She had to low weight on her doctor's advice.

So she planned to cook a nice but sober meal.

b. Sally Jones got up early this morning.

She wanted to clean the house.

Her parents were coming to visit her.

She was looking forward to seeing them.

Sally weighs 80 kilograms.

She had to low weight on her doctor's advice.

So she planned to cook a nice but sober meal.

They also presented evidence that in comprehension material preceding an anaphoric referring expression becomes less accessible in memory when an overly explicit referring device occurs than when a less explicit expression is used, presumably because the comprehender assumes that a new discourse segment has begun and thus earlier material is less likely to be relevant.

### 2.3. Accessibility/position or semantic likelihood

Fukumura and van Gompel (2010) conducted several production studies to determine whether the likelihood of referring to a particular argument might determine the referring form that speakers choose. Consider the discourses in (9). It is well established that some Stimulus Experiencer verbs like *scare* are likely to refer to the subject in providing causal explanations (e.g., *Gary scared Anna because he...*) whereas Experiencer Stimulus verbs like *fear* are likely to refer to the object (e.g., *Gary feared Anna because she...*). In free completion of examples like (9), Fukumura and van Gompel confirmed this expectation but, crucially, even with Experiencer Stimulus verbs, where continuations referring to the object were more likely than continuations referring to the subject, pronouns were used just as often as with other verbs.

- (9) a. Gary scared (SE) Anna after the long discussion ended in a row (fight). This was because...  
b. Gary feared (ES) Anna after the long discussion ended in a row (fight). This was because...

The results suggest that what determines the use of a particular referring expression is not how likely the speaker is to refer to a particular argument but instead syntactic position (which presumably is correlated with discourse accessibility or discourse prominence).

In sum, the type of expression used to co-refer matters in identifying the referent but also in implicitly indicating breaks or continuity in discourse structure. Finally, the referring device that speakers chose is determined by discourse structure, not by semantic likelihood.

### 3. DOES THE AVAILABILITY OF COMPETITOR STRUCTURES MATTER?

In a series of pronoun comprehension studies in English, German and French, Hemforth and colleagues (e.g., Hemforth, Konieczny, Scheepers, Colonna, Schimke & Pynte, 2010, Colonna, Schimke, Hemforth, 2012, in press) have investigated the interpretation of pronouns in *before*-clauses, such as (10).

- (10) English: The postman met the street-sweeper before he went home.  
French: Le facteur a rencontré le balayeur avant qu'il rentre à la maison.  
German: Der Briefträger hat den Strassenfeger getroffen bevor er nach Hause ging.

French shows a preference for object antecedents for pronouns in *before*-clauses in contrast to English and German, and in contrast to the general preference for subject antecedents for subject pronouns in all three languages. The preference for a subject antecedent is not surprising. But the preference in French for an object antecedent is surprising. Why does the object preference arise in French *before*-clauses?

Hemforth and colleagues note that there is a competitor structure in French, where a null subject in an infinitival clause receives a subject interpretation (11). So one might imagine a Gricean explanation: if the speaker had intended a subject antecedent, the competitor structure would have been used. The problem is in English too there is a possible competitor structure: a participial structure (12).

(11) Le facteur a rencontré le balayeur avant de rentrer à la maison  
'The postman met the street-sweeper before to go home.'

(12) The postman met the street-sweeper before going home.

So why doesn't the English competitor structure have the same effect as in French?

The difference between the French and the English competitor structures may be a matter of usage. In a very small corpus study (100 sentences for each language), there were 77% subject antecedents in German (in the *Frankfurter Rundschau*), 64% subject antecedents in English (in the *Wall St Journal*), and 100% (*Le Monde*) or 85% (Google News Group) **object** antecedents in French. The results thus suggest that competition from other structures plays an important role in determining antecedent preferences, but it is competition **in practice** that matters. Whether the usage patterns exert their influence through stored frequencies, or just through implicit knowledge of the production system, is not entirely clear at present. Nevertheless, the results suggest we should expect to find cross-language differences in interpretive preferences. Indeed, Kaiser (2010) examined pronominals in Finnish and Estonian and argued that different languages, indeed, different pronominal forms within a language, may be associated with their own characteristic preferences for the position of their antecedent.

It is not entirely clear at present whether it is primarily the base position of a phrase or its surface position that controls antecedent preferences in languages where a given phrase may occupy many different positions due to fronting, topicalization, scrambling or the like. In German, subject antecedents are preferred independent of their position (Bouma and Hopp, 2006). However, objects are more likely to be chosen as antecedents in Topic position (56%) than in base position (30%).

As for the possibility that there are deep typological differences in co-reference and anaphora, e.g., different principles at work in Topic prominent languages than in Subject prominent languages (most of those discussed so far), the limited evidence available at present suggests not, at least to me. For example, in eye movement recording studies, Lee, Lee and Gordon (2007) examined the processing of matrix clause and embedded clause subjects in Korean, varying the type of NP: pronoun, name or description. Sentences were read fastest when the more definite (pronoun, name) appeared in the more prominent syntactic position (the matrix clause subject) and the less definite (description) appeared in the less prominent syntactic position (embedded clause subject). Although it is the position of the referring expression, not its antecedent, at issue in this study, the underlying principles involved seem familiar: expressions which take highly accessible antecedents (pronouns) appear in syntactically prominent positions as do their antecedents.

#### 4. GRAMMATICAL FEATURES IN PROCESSING (CO-) REFERENCE

Much of the psycholinguistic evidence on feature processing comes from language production studies. In language production, subject-verb number agreement errors are often produced when a local noun is plural and the head noun is singular, as in *\*The key to the cabinets are..* Such ‘local attraction’ errors are especially common when the head noun is collective (Bock et al., 1999, 2006) or when the subject has a ‘distributive’ interpretation (Bock, Carreiras and Meseguer, 2012). But, interestingly, the effects of these semantic manipulations are dramatically stronger when pronominals (reflexives, pronouns in tag-questions) are tested rather than subject verb agreement. For example, Bock et al. (1999) used a between-subject manipulation in which the task was either the usual task of repeating a preamble and continuing it with a verb, or the task was to produce a reflexive pronoun after repeating a preamble, as in (13a), or produce a tag pronoun, as in (13b) (where the lower case indicates the preamble and upper case the continuation).

- (13) a. The cast in the soap operas watched THEMSELVES.  
b. The cast in the soap operas rehearsed, DIDN'T THEY?

Bock et al. tested singular and plural count nouns as the head, as well as singular collectives. When the head was collective and the local noun was singular, 36% plural verbs were produced. However, plural reflexive and tag pronouns were each produced over 70% of the time when the head was collective and the local noun was singular.

In comprehension too, a local plural noun has effects: it mitigates the penalty for ungrammatical plural verbs (Pearlmutter, Garnsey, and Bock (1999, Van Gompel & Liversedge, 2003 Wagers, Lau and Phillips, 2009). Pearlmutter et al. used both self-paced reading and eyetracking and found reading time penalties only for number violations involving a local singular. With respect to anaphora, what's striking is that it is grammatical number that controls subject verb agreement, but ‘semantic’ number that controls reflexives. In eye movement recording studies using UK participants, Kreiner, Garrod and Sturt (2012) found long reading times in early and late measures for reflexive nouns bound by individual nouns (*student*) but not for plural reflexives bound by collective nouns (*class*). Further, in another study, the reading times for reflexives were independent of the grammatical number on the verb. In sentences like (14a) with a singular marked verb, *themselves* was read as quickly as in (14b) with the ambiguously marked verb.

- (14) a. The government constant **avoids** criticizing **itself/themselves** about the unbalanced budget.  
b. The government constant **avoided** criticizing **itself/themselves** about the unbalanced budget.

The results suggest that phrases must be represented at distinct levels of representation. For pronominals including reflexives, the semantic representation is critical even if it is accessed through the syntactic representation.

Carminati (2005) investigated the feature hierarchy (Person > Number > Gender) in Italian sentences where a null pronominal was forced to its unpreferred object antecedent interpretation by Person features, Number features, or Gender. In self-paced reading studies, she found that the penalty for an object antecedent was larger when Gender disambiguated (15b vs 15a) than when Number disambiguated (15d vs 15b).

- (15) a. Quando Maria cerca Roberto, diventa ansiosa.  
 ‘When Maria looks for Roberto, pro becomes anxious (fem).’  
 b. Quando Maria cerca Roberto, diventa ansioso.  
 ‘When Maria looks for Roberto, pro becomes anxious (msc).’ (Gender disambiguation)  
 c. Quando Maria lo cerca, diventa ansioso.  
 ‘When Maria looks for Roberto, pro becomes anxious (msc).’ (Gender disambiguation)  
 d. Quando I Rossi lo cercano, diventa ansioso.  
 ‘When the Rossis look for him, pro becomes anxious (msc).’ (Number disambiguation)

If number and person disambiguated, the penalty was smaller than if number alone disambiguated. This suggests that the feature hierarchy, originally motivated by typological facts (a language which contains features lower on the hierarchy will also contain higher features), also plays a role in language processing. Features higher on the hierarchy disambiguate more strongly than features lower on the hierarchy. (Nevins, et al. 2007 find that Person features differ from Number features, using evidence from an ERP study and acceptability judgment study in Hindi). Finally, Carminati also tested and found support for the Person sub-hierarchy: P1,P2 > P3. Carminati suggested that Person and Number may act as stronger disambiguators than Gender because they have a representation in the syntax. Further, first and second Person features may be particular strong disambiguators because they are represented in the highest syntactic projection, which encodes Speech Act (Cinque, 1999, Speas and Tenny, 2003)<sup>1</sup>. See too Antón-Méndez, et. al, 2002, Barber and Carreieras, 2005.

## 5. CONCLUSIONS

There is a vast and fascinating literature on processing co-reference and anaphora of various sorts. The present overview has only skimmed the surface. But what is relatively clear is that Binding Theory filters the antecedents that are considered early in the processing of pronouns and anaphors. The grammatical function and position of the antecedent (and to some extent of the anaphor) are extremely important at least in part due to the fact that they encode likely discourse prominence in the absence of a fully specified discourse structure.

The form of the referring device is also important. Anaphora involving pronouns is strictly regulated in the sense that not choosing the expected referring form (e.g, not choosing a pronoun, when the antecedent/referent is very prominent) in effect signals a break in the discourse structure. Apparently creating a coherent discourse, not ambiguity avoidance, is the basic determinant of the production of anaphoric forms, and thus reflected too in the processing of pronouns.

Cross-language studies make it clear that although the forms available for use differ across languages, highly similar principles seem to be involved. Topic-antecedent and subject-antecedent preferences are common across languages. However, competition from an often used structure with the same interpretation as a subject-antecedent clearly can shift the preferred antecedent of a pronoun to object, as in the French studies discussed above, see Hemforth et al., 2010.

Both grammatical features and the semantic properties of antecedents are important in processing pronominals. In ways just beginning to be understood, some grammatical features are anchored differently than others (see note 1) and serve as disambiguators that are stronger and perhaps processed

1. Mancini (2012) develops this line of argumentation drawing on the structural assumptions of Sigurdsson (2004). As illustrated in (i), Sigurdsson divides the syntactic tree into three regions. The vP region, a lexical projection specifying the property of events is the lowest. The region between vP and IP is devoted to grammatical (morphosyntactic) features including Tense, Modality, Number and Person. The

differently. Person features seem to disambiguate to unpreferred interpretations more effectively than Number features, for example, possibly due to a discourse/speech act interpretive anchor for Person but not Number (Carminati, 2005, Mancini, 2012). On the other hand, semantic properties of the antecedent such as collectivity are important even for pronominals disambiguated by Number.

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## CORREFERÊNCIA E COMPREENSÃO DA LÍNGUA ADULTA

### RESUMO

Existe uma vasta literatura, rica e variada sobre o processamento de pronomes e outras formas anafóricas na literatura de compreensão da língua adulta. Ao invés de tentar rever tudo, uma tarefa impossível em um espaço pequeno, algumas conclusões que serão discutidas são particularmente informativas ou porque elas colocam fortes restrições sobre o tratamento de correferência e mais geralmente na anáfora ou porque apresentam problemas ou desafios para uma teoria adequada de processamento da anáfora.

**PALAVRAS-CHAVE:** processamento de pronomes, correferência, anáfora

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highest region includes notions related to discourse, including Speech Act Location and Time, Topic, features for Agent of Speech Act and Participant of Speech Act, as well as Force.

(i) [ CP Force ... [ IP Person Number M Tense [vP ]]]

Mancini suggests the Feature Interpretation procedure in (ii).

- (ii) A feature is interpreted in relation to its anchor.
- The anchor for Person resides in the speech act participant layer.
  - The anchor for Number resides in the subject argument.

What this interpretation procedure suggests is that interpreting Number requires only reference to the morpho-syntactic features, which are anchored in Spec,IP, whereas interpreting Person requires access beyond the morpho-syntactic features, namely, to the discourse/speech act layer. In ERP studies, in line with this account, Number violations gave rise to LAN effects, also observed for local phrase structure violations, whereas Person violations gave rise to N400 effects, which are also observed for 'semantic/discourse' violations.

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