

A constraint-based approach to pronoun interpretation in Italian

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Keywords: pronoun interpretation; cognitive modeling; pro-drop; constraint-based modeling

Introduction

Anaphoric pronouns such as the English ‘he’ are used in daily life to refer to entities that are mentioned in the previous discourse context. Such pronouns are ambiguous, as they can refer to any singular male entity in the discourse. Ambiguous pronouns have to be resolved in order to be (correctly) interpreted. Generally, third person pronouns are interpreted as referring to the grammatical subject of the previous sentence (subject bias; Gordon & Searce, 1995), or as referring to the discourse topic (most accessible antecedent; Ariel, 1990; Grosz, Weinstein, & Joshi, 1995), resulting in topic continuation.

The resolution of ambiguous pronouns and taking into account the previous discourse context requires processing. With a constraint-based approach (derived from Optimality Theory; Prince & Smolensky, 2008), we try to identify rules (constraints) that guide this pronoun resolution process. We propose a number of constraints that, when implemented in a cognitive model, can simulate pronoun processing in Italian.

Pronoun interpretation in Italian

In pro-drop languages like Italian, contrary to non-pro-drop languages such as Dutch and English, a rich verb morphology allows for an additional subject form: the subject can be completely omitted, resulting in a null subject. Italian thus offers the possibility to either place a subject pronoun overtly or to use a null subject. Generally, a null pronoun refers to the previous discourse topic, whereas an overt pronoun refers to another, non-topical, referent (Carminati, 2002). However, this is merely a preference and interpretations of null as well as overt pronouns can vary.

So, a potential model of pronoun resolution in Italian can not simply take the topical character or the grammatical subject of the previous sentence as the referent of the pronoun, but will need more elaborate constraints. First, we ran an experiment to examine how different Italian subject forms are interpreted in discourse.

Experiment

In the experiment, Italian adults (n=40) heard short stories, the last clause of which contained one of three different subject anaphora: A full noun phrase (NP) such as *the dog* as an unambiguous baseline condition, a null subject (\emptyset), and the overt subject pronouns *lui* (‘he’) and *lei* (‘she’). A sample story:

Il cane va a fare un viaggio in Germania.

The dog is going on a trip to Germany.

Ieri sera il cane ha invitato il gatto a viaggiare insieme, Last night the dog has invited the cat to travel together, mentre \emptyset /lui/il cane si lavava prima della partenza.

while \emptyset /he/the dog washed himself before the departure.

We recorded participants’ responses to a referent selection question, in which they could choose between the discourse topic (*il cane*) and a non-topic antecedent (*il gatto*) as the referent of the subject anaphor.

The results of the experiment (Figure 1) show that, in line with Carminati (2002), null subjects are generally interpreted as referring to the discourse topic (86% of the time). Interpretations of overt subject pronouns vary somewhat, as they are interpreted as referring to the discourse topic 39% of the time and as referring to the non-topical referent 61% of the time.

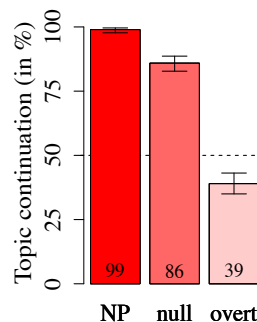


Figure 1: Experimental results for the interpretations of full NPs, null subjects, and overt subject pronouns in Italian.

Proposed model

We propose an adaption of the pronoun resolution model of Van Rij, Van Rijn, & Hendriks (2011) in order to simulate the processing and interpretation of Italian pronouns. The model is to be implemented in the cognitive architecture ACT-R (Anderson, 2007), which constrains models to ensure psychological plausibility. The proposed model uses the following, hierarchically ordered, constraints:

- [1] There are no null subjects that refer to a non-topical
- [2] There are no pronouns that refer to an entity that is not activated
- [3] Avoid NPs
- [4] Avoid overt pronouns

There three main steps in the model: determining the discourse topic, interpreting the pronoun, and perspective-taking. In this final step, the model takes the perspective of the speaker in order to determine if a speaker would indeed have used the encountered expression for the selected interpretation.

In the first step the character with the highest activation is taken as the current discourse topic. The activation of a referent is based on the previous occurrences in the discourse and its grammatical role during these occurrences. Mistakes can be made when determining the discourse topic because activation in ACT-R is subject to noise.

In the second step of the model, either a null subject or an overt subject pronoun needs to be interpreted. For Italian null subjects the discourse topic is taken as the referent of the pronoun based on constraint [1]. For overt subject pronouns however, the constraints do not restrict the interpretation to either the topic or to a non-topical, activated antecedent. Therefore, the referent of an overt subject pronoun can not be determined in this step.

In this case, the third step of taking into account the perspective of the speaker is essential. This final step can have three possible input states: either the speaker wants to refer to the discourse topic, to a non-topical, activated antecedent, or to a non-topical antecedent that is not activated. If the intended referent is the topic, constraints [1] and [2] do not restrict which form can be used. In this case, constraints [3] and [4] are applied: a null subject is easier (less effortful, more economic) to produce than an overt subject pronoun, which is easier to produce than a full NP (based on Burzio, 1998). Thus, if a speaker would want to refer to the discourse topic, she would use a null subject.

When the speaker wants to refer to a non-topic, constraint [1] does not apply. If the antecedent is not activated in the current discourse, the speaker will not use a pronoun (on the basis of constraint [2]), so she will use a full NP. If the non-topic antecedent is activated in the discourse however, constraint [1] still prevents the speaker from using a null subject, but constraint [2] does not apply. Therefore, constraint [3] determines that an overt subject pronoun is used instead of a full NP. So, because a speaker would use an overt pronoun to refer to a non-topical, activated

antecedent, a listener would finally interpret an overt subject pronoun as referring to the non-topical, activated character.

So far, we have explained the hierarchical constraints and processing steps, which together lead to the correct interpretation preferences for null and overt subject pronouns. Additionally, activation in ACT-R is subject to noise and thus pronouns will not always be interpreted in the same way. However, the model should also account for the strong variation in the interpretations of overt subject pronouns. This can be simulated by the third step of the model, the perspective-taking step, which is necessary for the interpretation of overt subject pronouns but not for null subjects. Since the execution of an additional processing step takes time and effort, time constraints on language processing may prevent the third processing step from being completed. If the interpretation of the overt subject pronoun has not been determined yet, it will be guessed. This will result in more variability in the interpretation of overt subject pronouns than in the interpretation of null subjects.

Conclusions

In this paper, we propose a model that uses a constraint-based approach and perspective-taking. Combined with constraints from the cognitive architecture ACT-R and constraints on language processing, the model can plausibly simulate subject pronoun interpretation in Italian.

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