

# Predicative NPs and the annotation of reference chains

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## Abstract

In the development of machine learning systems for identification of reference chains, hand-annotated corpora play a crucial role. This paper concerns the question of how predicative NPs should be annotated w.r.t. coreference in corpora for such systems. This question highlights the tension that sometimes appears in the development of corpora between linguistic considerations and the aim for perfection on the one hand and practical applications and the aim for efficiency on the other. Many current projects that seek to identify coreferential links automatically, assume an annotation strategy which instructs the annotator to mark a predicative NP as coreferential with its subject if it is part of a positive sentence. This paper argues that such a representation is not linguistically plausible, and that it will fail to generate an optimal result.

## 1 Introduction

Predicative NPs in positive sentences are marked as coreferential with their subject in many projects that develop corpora for coreference chains. This is exemplified by the annotation scheme of MUC-7 (Hirschman and Chinchor, 1997), on which several annotation schemes are based. Also in more theoretical works this has been a common mark-up, at least for definite predicative NPs. For example, the proper name *David Beckham* and the definite phrase *the second best player in the world* in (1) below are regarded as coreferential and anaphorically related to each other by Mitkov (2002), whose intention seems to be to present the standard view on this issue.

- (1) David Beckham was voted the second best player in the world behind Rivaldo.

There are several arguments in favor of treating a predicative NP and its subject as part of

the same reference chain if they appear in a positive sentence. A predicative NP and its subject are often used to describe the same individual in the world. As the goal for automatic identification of reference chains is primarily to identify equivalence sets, i.e. sets of nominals that refer to the same entity, this is a strong argument for assuming coreference between predicative NPs and their subject.

A second argument in favor of this is that one otherwise loses important information about referents in terms of descriptive content. Consider the following example:

- (2) Skogfoss is your parents' farm, isn't it?  
I remember that farm.

In (2) above, we want to capture the fact that *Skogfoss* and *that farm* refer to the same entity. If one assumes an annotation strategy where *Skogfoss* and the predicative NP *your parents' farm* are marked as part of the same reference chain, then the descriptive content contributed by *farm* is added to the reference chain, which in turn makes it highly likely that the later expression *that farm* belongs to the same reference chain, as desired. In other words, the descriptive content contributed by a predicative phrase - if assumed to be coreferential with its subject - can be useful for identifying desired subsequent coreferences. Correspondingly, it can also be useful for ruling out undesired ones.

The fact that the majority of annotated corpora for coreference identification mark predicative NPs in positive sentences as coreferential with their subject, is in other words quite well motivated. Still, we will claim that it is legitimate to question the plausibility of this practice, due to facts that we will look at in the next section. These arguments give support to van Deemter and Kibble (2000), who argue that it is problematic that the annotation strategy assumed in MUC-6 and MUC-7 goes beyond a mark-up of coreference.

## 2 Why non-reflexive predicative NPs are not anaphoric to their subject

Reference chains may be marked in terms of set membership, but they can also be marked in terms of anaphor-antecedent pairs. We therefore want to consider whether it is plausible to assume that predicative NPs are anaphoric to their subject.

An anaphor is often defined as a constituent whose interpretation is dependent on some meaning aspect of a prior constituent, called the antecedent. The need for an antecedent is assumed to be due to an impoverished semantic content in the anaphor itself, and typically, the antecedent is a more complete semantic description. There are different types of anaphor-antecedent relations, but we will focus on anaphor-antecedent relations that encode identity of reference. In such relations, nominal forms play an important role in identifying an anaphor's antecedent, as different nominal forms signal different attention states for the associated referent (Gundel et al., 1993).

Given this notion of anaphor, we will mention four reasons not to assume that predicative NPs are anaphorically related to their subject.

First, it is inherent in the notions *anaphor* and *antecedent* that the antecedent is the source of interpretation for the anaphor. Thus, if an anaphor's antecedent is identified and interpreted, the anaphor is supposed to be interpretable as well. If one assumes that predicative NPs are anaphoric to their subject, this raises the expectation that a predicative NP will always be interpretable as long as its subject is interpreted. But this is not always the case:

- (3) a. Fido is the dog I talked about.  
b. A: Who is the witch in this play?  
B: I am the witch.

In (3a), imagine a situation where Fido is present in the immediate context, so that the subject phrase *Fido* can easily be understood. Assuming that predicative NPs are anaphoric to their subject, this should mean that the predicative NP *the dog I talked about* can be sufficiently interpreted without any special contextual requirements except from the sentence itself and the presence of Fido. But this is not the case, as *the dog I talked about* can only be fully understood if the phrase has some other antecedent than *Fido*. Thus, in this case, identifying the subject as the antecedent of a predicative NP

is not sufficient to interpret the predicative NP. The example in (3b) is another case where a predicative NP does not seem to be anaphorically related to its subject. The phrase *the witch* in B's reply is an anaphor, as it cannot be interpreted in isolation. As for its antecedent, it makes more sense to say that it has *the witch in this play* as its antecedent than the subject phrase *I*. *I* is not anaphoric to the expression *the witch in this play*, as the interpretation of *I* is independent of it. Thus, if one assumes that the subject phrase *I* is the antecedent of the predicative phrase *the witch* in (3b), then one does not get access to the desired information that the predicative phrase *the witch* refers to the same witch as does the prior phrase *the witch in this play*. In sum, the examples in (3) show that assuming coreference between a predicative NP and its subject in a positive predicative sentence is not always enough to interpret the predicative NP. This, in turn, suggests that a predicative NP and its subject in a positive sentence do not always stand in an anaphor-antecedent relation to each other.

Something that supports this suggestion is that it is hard to find differences between positive and negative predicative sentences w.r.t. the interpretation of the predicative phrase. Obviously, predicative NPs in negated sentences are not coreferential with their subjects, and not anaphorically related to them. If a predicative NP and its subject were necessarily anaphorically related in positive sentences, one would expect that the interpretation of a predicative NP in a positive sentence would be less context-dependent than for a corresponding isolated negative sentence, due to the presence of a sentence-internal antecedent. But examples that support this expectation are hard to find, and have not yet been detected by this author. It seems that in both positive and negative predicative sentences the predicative phrase can be interpreted and sufficiently understood independently of its subject.

A third argument for not assuming that predicative NPs in positive sentences are anaphoric to their subject is that they do not follow the normal pattern for anaphoric expressions w.r.t. NP-form. Whereas anaphora are often pronominal and only very rarely indefinite, predicative NPs are hardly ever pronominal and quite often indefinite. The contrast w.r.t. nominal form is illustrated by the following text fragments:

- (4) a. Kari is in good shape. She is often

exercising. She/ a sporty girl bikes to work every day.

- b. Kari is in good shape. She is often exercising. She is a sporty girl.

In (4a), the two occurrences of the pronoun *she* are interpreted as referring to Kari. The indefinite phrase *a sporty girl*, on the other hand, is not likely to refer to Kari in (4a); rather, the phrase is interpreted generically. This illustrates the fact that indefinite NPs are bad candidates for being anaphora. This tendency does not hold for predicative NPs, though, assuming that they are anaphora. This is shown in (4b), where we see that an indefinite predicative NP can very well be preceded by a pronoun that describes the same individual as the predicative NP. In other words, if one assumes that predicative NPs are anaphoric to their subject, one has to explain why predicative NPs do not have the expected forms of nominal anaphora.<sup>1</sup> Predicative NPs are typically either indefinite or initiated by the definite article, which are forms that do not require previous familiarity with the referent (Gundel et al., 1993).

A fourth argument for not treating predicative NPs as anaphoric to their subject has to do with binding principles (Chomsky, 1981). The interpretation of a reflexive predicative NP is dependent on the interpretation of its subject, so we take it as uncontroversial that a reflexive predicative NP like the one in (5a) is anaphoric to its subject, just as the reflexive in (5b).

- (5) a. She has always been herself.
- b. She blamed herself.

Usually, in positions that license reflexives, full lexical NPs cannot be inserted without affecting the interpretation. This is illustrated by the contrast between (5b) above and (6b) below.

- (6) a. She has always been my best friend.
- b. She blamed my best friend.

There is a very strong preference for interpreting *my best friend* and *she* in (6b) as referring

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<sup>1</sup>Mitkov (2002) suggests that whereas definite predicative NPs should be regarded as anaphoric to their subject, indefinite ones should not be regarded as such. This solves the problem that predicative NPs are often indefinite, whereas most anaphora are not. However, this distinction between indefinite and definite predicative NPs does not solve the more general problem that definite as well as indefinite predicative NPs do not seem to get their interpretation through their subject.

to different individuals, and it is impossible to use (6b) to enforce coreference between the object and the subject, as in (5b). This illustrates the motivation for a binding principle which predicts, among other things, that a lexical NP cannot be anaphorically bound by a co-argument.

If we say that the lexical predicative NP in (6a) is anaphoric to, and coreferential with, its subject, then we have to assume that there are different binding principles for the arguments of the verb *be* than for other verbs. The difference is then that with predicative NPs, unlike non-predicative ones, both reflexive and nonreflexive NPs can appear in the same position with the same anaphoric interpretation. If we, on the other hand, do not assume coreference and an anaphor-antecedent relation in (6a), we can do with one general binding principle.

### 3 Discussion

In section 2 we have seen arguments which suggest that non-reflexive predicative NPs are not anaphoric to their subject. First of all, assuming that a predicative NP is coreferential with its subject is not always enough to assign it an interpretation. Secondly, contrary to what one would expect, there is no difference between positive and negative predicative sentences w.r.t. the context-dependency of the predicative phrase. Thirdly, non-reflexive predicative NPs do not have the forms that are expected for nominal anaphora. And finally, non-reflexive predicative NPs behave differently w.r.t. binding than what is expected if they are assumed to be anaphora.

These facts suggest that the reason why many predicative NPs are intuitively seen as describing the same individual as their subject is a different reason from that which identifies the antecedent of an anaphor. We propose that non-reflexive predicative NPs are not anaphoric to their subject, but rather part of a *predication* which holds of the subject referent.

But marking coreference is not necessarily the same as marking anaphor-antecedent pairs, as reference chains can also be thought of in terms of equivalence sets. So does the conclusion that non-reflexive predicative NPs are not anaphoric to their subject mean that one should never annotate predicative NPs as *coreferential* with their subject when building corpora with reference chains? As far as we can see, that depends on the intended application for the system, on the machine learning system's abilities, and on

what additional information is available or retrievable from the corpus and/or the system.

On the one hand: As long as the machine learning method applied is capable of learning two different systems at once, it may be desirable to include predicative NPs in the same reference chain as their subject, if part of positive sentences. As argued in section 1, predicative NPs in positive sentences do describe the same individual as their subject does, and the semantic information in predicative NPs can be useful for identifying desired later coreferences and ruling out undesired ones. For practical applications it is a goal to collect equivalence classes, and the richer these are, the better. The approach is furthermore not very effort-demanding. The drawback of the approach is that it seems to mix two distinct phenomena, i.e. reference tracking and predication. The annotation strategy is therefore theoretically questionable and is likely to lead to unsatisfactory results in some cases, as illustrated by the examples in (3).

On the other hand: Imagine a system where referents are not seen as individuals in the world, but abstract entities where e.g. (1) states a *be*-relation between the discourse referent associated with David Beckham and the intensional object corresponding to the second best player in the world. Imagine further that one distinguishes between (discourse) referent tracking and collection of predications. Predicative NPs will only be annotated as coreferential with their subject if they are reflexive, but any predicative NP will be kept track of as part of a predication that holds of its subject referent. Thus, there are two sources of information about referents; the descriptions used to refer to them, and predications made about them. The latter source will be of importance for reference tracking also independently of predicative NPs. Consider (7).

- (7) Fred drives a taxi, whereas Joe studies math. Who would you prefer to meet, the math student or the taxi driver?

The information retrieved from the predications about Fred and Joe is crucial to assign the correct interpretation to the expressions *the math student* and *the taxi driver*. If predications about referents are kept track of just as well as reference chains, then we are in principle able to achieve the correct interpretation for (7).

Thus, with the present approach, which keeps reference tracking and predication track-

ing apart, it is not necessary to assume that predicative NPs are coreferential with their subject in order to exploit the important semantic information they may contribute about the subject referent. The present approach is also more theoretically plausible in that it singles out two arguably distinct phenomena, and it is not likely to go wrong in cases like those in (3). The main drawback of this approach is that it is effort-demanding, as it requires a semantic component that keeps track of predications as well as referents. Such a component is not part of most current automatic systems for reference tracking, and without it, the approach produces less information about referents than its competitor described above. For instance, without the component to keep track of predications, one doesn't capture the fact that a predicative NP in a positive sentence is a property of the subject referent, whereas a predicative NP in a negative sentence is not.

## 4 Conclusion

We claim that the common practise in annotation of reference chains conflates two distinct phenomena when it comes to predicative NPs; i.e. reference tracking on the one hand and tracking of predications on the other. We acknowledge that this conflation may be the most efficient and successful approach at the time being, but we believe that treating these two phenomena as distinct will turn out to be the most successful approach when richer systems are being developed. The Norwegian coreference task project BREDT (see <http://ling.uib.no/BREDT/>) follows this latter strategy.

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