

# COMPLEX ANAPHORS – ONTOLOGY AND RESOLUTION<sup>1</sup>

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We will describe anaphoric complexation processes and their constraints in terms of ontological categories. Furthermore, we will provide a resolution model for complex anaphors based on semantic as well as conceptual structures, thus integrating DRT and cognitive approaches. An example of an ambiguous complex anaphor will be discussed in order to show the role of ontological constraints in complex anaphora processing.

## 1. Introduction

Complex anaphors are nominal expressions referring to propositionally structured referents<sup>2</sup> (such as propositions, states, facts and events) while introducing them as unified entities into a discourse representation. Additionally, they can classify or evaluate the referent.

- (1) *Young drivers usually drive too fast. This/ this fact/ this image/ this impertinence ...*

Researchers have referred to complex anaphors heterogenously, e.g. *abstract object anaphora* (Asher 1993, 2000) or *situational anaphora* (cf. Fraurud 1992). From a semantic point of view, complex anaphors present DRT-approaches with a challenge, as resolving them involves conceptual knowledge.

## 2. On Complexation Processes

Complex referents are propositionally structured objects, that have been topic of several detailed analyses: There is no final agreement on the ontological categorisation of such

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<sup>2</sup> “Let us here use ‘referent’ for the discourse entity referred to, regardless of its level of representation“ (Fraurud 1992: 26). For levels of representation see section 3.

referents as events, states, processes or situations (cf. Asher 1993, 2000, Higginbotham 2000, and Maienborn 2003). Nonetheless, we get the following classification showing the increasing abstractness of the proposed ontological types.

(fig. 1): degree of abstractness      ontological category

<p><b>high</b></p> <p>↑</p> <p><b>low</b></p>	<p>proposition (pp)</p> <p>fact (f)      [-dependent on world]</p> <p>state (s)      [-dynamic, -telic / dependent on world and time]</p> <p>process (p)    [+dynamic, -telic / dependent on world and time]</p> <p>event (e)      [+dynamic, +telic / dependent on world and time]</p>
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### 2.1 Types of Complexation Processes

Now let us have a closer look at the complexation process. We distinguish between three types of complex anaphoric reference (s. (a) – (c)).

(a) The ontological status of the referents stays the same during the anaphoric process, since the antecedent and the anaphor denote the same ontological type ( $z_x \approx x$ )<sup>3</sup>, s. (2).

- (2) [*The Americans tried to invade the building but were forced back by shots from the top floor.*]<sub>e</sub> It is said that two soldiers were injured during [*this action*]<sub>e</sub>, one inside the house and the other one outside the house. (TigerKorpus)

(b) The anaphorical expression itself is neutral with respect to ontological types. For this reason, the discourse entity established by the anaphoric process usually keeps the ontological type denoted by the antecedent ( $z_{\text{neutral}} \approx x$ ).

- (3) [*The Americans tried to invade the building but were forced back by shots from the top floor.*]<sub>e</sub> [*This*]<sub>n</sub> happened yesterday while Mr. Rumsfeld visited Bagdad.

Even though the anaphor is neutral with respect to ontological types, there are cases where a different type is fixed by the syntactic/semantic context provided by the sentence the anaphor is part of. In (4), the event-referent must be factual in order to serve as a proof.

- (4) [*The Americans tried to invade the building but were forced back by shots from the top floor.*]<sub>e</sub> [*This*]<sub>n</sub> proves that the situation isn't under control yet.

(c) Due to its lexical meaning, the anaphoric expression denotes another ontological type than its antecedent. Thus, the anaphorical process changes the ontological type of the referent ( $z_x \approx y$ ).

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<sup>3</sup> '≈' assigns a complex referent (x) to an anaphor (z) (cf. Asher 1993: 145).

- (5) [*The Americans tried to invade the building but were forced back by shots from the top floor.*]<sub>e</sub> [*This fact*]<sub>f</sub> proves that the situation isn't under control yet.

In (5) the event referent denoted by the antecedent becomes a fact.

- (6) [*Instead of working on her training report, she went out to eat ice cream.*]<sub>e</sub> I won't tolerate [*this hanging out*]<sub>s</sub> any longer. (oral communication)

Here the single event (the referent's going out to eat ice cream) is released from its concrete temporal and spatial fixation by the state-anaphor *hanging out*, thus it is understood as a typical, exemplary incident.

## 2.2 Constraints on Ontology Changing Complexation

- (7) [*The earth turns about the sun.*]<sub>p</sub> [*This process*]<sub>p</sub> / [*This state*]<sub>s</sub> will presumably last for  $7 \cdot 10^9$  years. [*This fact*]<sub>f</sub> is well known since the Middle Ages. Researchers of the Vatican were not allowed to examine [*this possibility*]<sub>pp</sub> / \**[This event]*<sub>e</sub>...

As the example shows, anaphorical complexation can shift referents of any ontological type to a discourse entity of either the same ontological type or an ontological type that is more abstract. Thus, anaphorical complexation can be a process of increasing abstractness (s. fig. 1).

- (8)  $*z_y \approx x$  if  $x > y$  ("if x is higher on abstractness scale than y")

This 'abstractness-constraint' can serve to explain ontological based resolution of ambiguous complex anaphors:

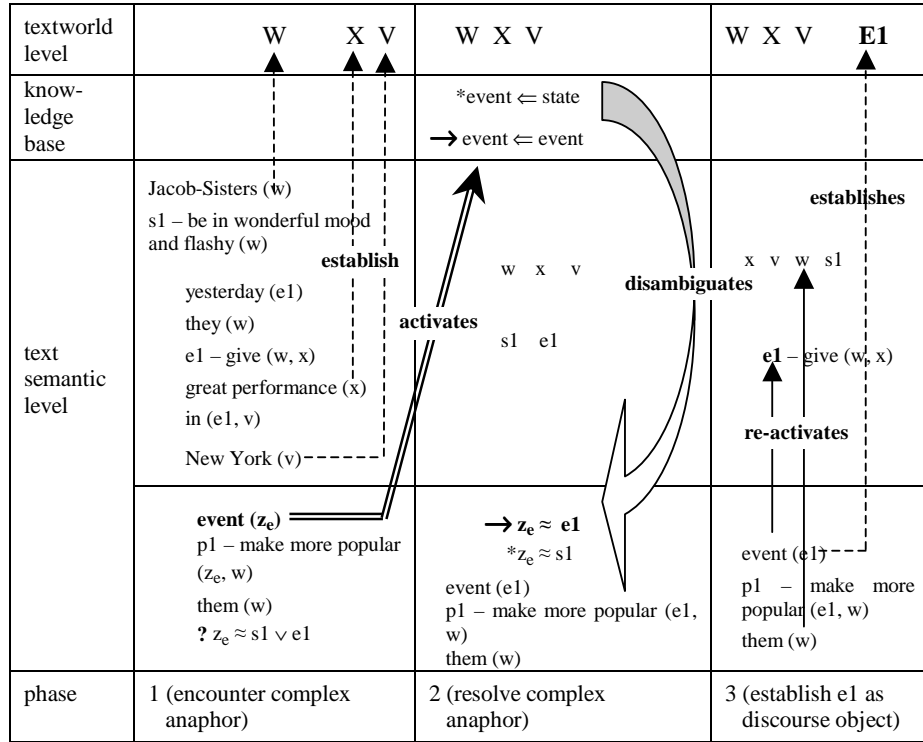
- (9) [*The Jacobs-Sisters are always in a wonderful mood and flashy.*]<sub>s</sub> [*Yesterday they had a great performance in New York.*]<sub>e</sub>  
 (a) [*This event*]<sub>e</sub> has surely made them even more popular.  
 (b) [*This quality*]<sub>s</sub> has surely made them even more popular.  
 (c) [*This/that*]<sub>n</sub> has surely made them even more popular.

The two complex anaphors ((a) vs. (b)) have different antecedents, although both sentences in (9) are accessible as possible antecedents for both of the anaphors from a pure structural point of view (as version (c) shows). However, the first sentence is ruled out as antecedent in case of (a) since an event-anaphor cannot be assigned to a state-antecedent. In case of (b), there is no such restriction (as (6) shows it is possible to assign state-anaphors to event-antecedents in principle) but there seems to be a preference for an antecedent of the same ontological type if provided by the preceding text. These kinds of disambiguation are difficult to explain in terms of purely structural constraints (like DRT-approaches).

### 3. Processing Complex Anaphors

So in our model (taken from Consten / Knees forthc.) we will integrate procedural aspects in using a combination of DRS and cognitive Textworld Models (Schwarz 2001). We distinguish between different levels: the text semantic level, the textworld level and the knowledge base.

(fig. 2) Resolution model for (9a)



Referents are introduced by textual structures at the text semantic level. The nominal expressions *Jacob-Sisters*, *great performance* etc. in example (9a) introduce referents at the text semantic level (w, x... as illustrated in fig. 2).<sup>4</sup> Moreover, as nominal

<sup>4</sup> *They* in the second sentence is immediately resolved to the Jacobs-Sisters since it refers to the only plural

expressions they directly establish discourse entities at the textworld level (W, X...) by activating the corresponding concept in the long term memory (phase 1). The textworld level represents the discourse entities which are talked about in the discourse. In contrast to the nominal expressions, propositional expressions introduce complex referents (like events, states etc.) only into the text semantic level (e1, s1...) but they do not establish discourse entities at the textworld level. The knowledge base contains different sources of knowledge e.g. lexical or conceptual knowledge.<sup>5</sup>

Initially, anaphors do not establish discourse entities at the textworld level but are interpreted at the text semantic level where the appropriate part of the textual structure is re-activated. In case of complex anaphors, these textual parts are propositionally structured. So in example (9a) the complex anaphor *z* (*this event*) of type *e* (“event”) denotes due to its lexical meaning an event-referent. In phase 2, the anaphor ( $z_e \approx e1$ ;  $*z_e \approx s1$ ) and so the anaphor is assigned to the adequate prementioned referent. In phase 3 the anaphor re-activates this propositionally structured referent and thereby establishes it as a unified discourse entity E1 at the textworld level. Thus, complex anaphors differ from (direct) nominal anaphors as the latter refer to objects already introduced as discourse entities. DRT approaches do not reflect this difference as they assume that each incidence of an anaphor integrates a new discourse referent at the DRS (cf. the critical remarks in Löbner 1985: 320, Cornish 1999: 186, and Consten 2004: 61).

Once the complex referent is established as a unified discourse entity by a complex anaphor, the discourse entity is accessible by personal pronouns (as *it* in the 3<sup>rd</sup> sentence),<sup>6</sup> whereas the use of personal pronouns in the Vorfeld as a complex anaphor (as *it* in the 2<sup>nd</sup> sentence) is restricted (cf. Hegarty 2003):<sup>7</sup>

- (10) [*The earth turns about the sun.*]<sub>p</sub> [*This process*]<sub>p</sub> / [*This*]<sub>n</sub> / *\*[It]* will presumably last for 7·10<sup>9</sup> years. [*It*] might, however, terminate a few years earlier .

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entities previously introduced into the discourse namely the Jacobs-Sisters.

<sup>5</sup> We restrict our illustration to those parts of knowledge that are used in order to resolve the complex anaphor. The preferred interpretation is marked by an arrow in the figure.

<sup>6</sup> *It* in the 3<sup>rd</sup> sentence is not a complex anaphor since it is not assigned to a propositional structured antecedent but to a NP-antecedent (*This hanging out / This*) by which a unified discourse entity has already been established.

<sup>7</sup> Hegarty (2003: 1-2) assumes that events introduced by a clause are immediately accessible by personal pronouns since they are in focus merely due to their ontological status. However, some of our data does not support his claim. We have no evidence that ontological states of referents are determinants of a salience hierarchy.

#### 4. Summary

We have defined complex anaphors as anaphors that condense prementioned propositional referents establishing them as unified discourse entities. Anaphoric complexation is a process of increasing abstractness with respect to ontological categories. Thus, we distinguish between neutral and ontology changing complexation and propose an “abstractness constraint” which serves to explain the resolution of certain kinds of ambiguous complex anaphora not solved by current approaches. Our sketch of a process model of anaphoric complexation is able to integrate cognitive aspects of language processing into a formal semantic framework.

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