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This thesis was submitted by its author to the School of English and American Studies, Eötvös Loránd University, in partial fulfilment of the requirements for the degree of Master of Arts. It was found to be among the best theses submitted in 2016, therefore it was decorated with the School's Outstanding Thesis Award. As such it is published in the form it was submitted in **overSEAS 2016** (http://seas3.elte.hu/overseas/2016.html)

DIPLOMAMUNKA
MA THESIS

Tatár Csilla

Anglisztika MA

Angol elméleti nyelvészet szakirány

2016

A HKR 336. § ad 76. § (4) a) pontja értelmében:

„… A szakdolgozathoz csatolni kell egy nyilatkozatot arról, hogy a munka a hallgató saját szellemi terméke…"

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Budapest, 2016.04.12.   _____

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DIPLOMAMUNKA
MA THESIS

Az angol kataforikus szerkezetek szemantikai elemzése

A semantic analysis of English cataphoric constructions

Témavezető: **Készítette:**

Mekis Péter Ph.D.   Tatár Csilla

Adjunktus   Anglisztika MA

Angol elméleti nyelvészet szakirány

2016

Abstract

The purpose of the present study is to provide a dynamic semantic analysis of structures containing cataphoric reference. After introducing the problem from the points of view of the syntax-semantics interface, and the semantics-pragmatics interface in section two, section three reviews the problem of anaphors and two well-known frameworks that provide a semantic treatment for them; namely, Discourse Representation Theory and Dynamic Predicate Logic. Section three provides a parallel for the problem of cataphors detailed in section four, which also includes a brief recount of proposed analyses within the frameworks of Discourse Representation Theory and Dynamic Binding. Section five introduces two novel solutions for the treatment of cataphoric structures, both of which are compatible with a DPL framework with a referent system (such as the one in Coreference and Modality (1996)). The alternatives: (1) prohibiting semantically free variables, and (2) introducing interim discourse referents as transient objects with which syntactically free variables can be associated. The study concludes by arguing for the latter alternative, which—although a simple change in the system—provides a more refined analysis that has the expressive power to account for cataphoric structures without changing the order of the cataphor-antecedent sequence, thus representing more closely the hearer's interpretation of cataphors in natural language discourse.

Acknowledgements

Contents

1. Introduction

The subject of this study are cataphoric—or backwards anaphoric—constructions found in native English speakers' speech and writing. Special focus is given to pronominal cataphors with an indefinite noun phrase postcedent, although reference is made to cataphors of other types as well. As for structural specifications, interclausal and inter-sentential cataphors are examined more thoroughly. However, as cataphors, similarly to anaphors, can and do spread across larger chunks of discourse, this phenomenon is also of interest to this study.

The answer to the question as to why this subject should be of importance is manifold. First, a very simple reason comes to mind: as natural language phenomena, cataphoric constructions deserve an analysis. To my knowledge, however, they have largely been neglected—there are studies, but they are scarce.[1] Second, in the past few decades, linguists and logicians have given much attention to the reverse phenomena, anaphoric structures, especially to the theoretically challenging donkey sentences.[2] In the proposed theories and solutions for sentences containing anaphors—donkey or otherwise—there is next to nothing on sentences with cataphors, which might turn out to lend themselves readily to semantic analysis. Furthermore, cataphoric constructions appear to pose a threat to compositionality, as their interpretation heavily depends on contextual information that is provided as a postcedent, i.e. after the pronoun. The principle of compositionality in its least theoretically loaded phrasing given by Barbara H. Partee reads as follows: "the meaning of an expression is a function of the meanings of its parts and of the way they are syntactically combined"

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[1] One possible reason for this neglect could be that an entirely satisfactory analysis of anaphors (which may be considered the reverse of cataphors) is yet to be developed. However, with advancements in theoretical frameworks such as Discourse Representation Theory, Dynamic Predicate Logic, and Update Semantics, there is no reason why one should not make an attempt at analyzing both these phenomena alongside one another.

[2] Introduced in Geach (1962).

(Partee, 2004, p. 153). Frege's Principle[3] allows for a rule-by-rule analysis and modelling that a number of theoretical frameworks employ and build on in their methodology, and a possible threat to a principle of such constitutive significance should not be overlooked. The three primary reasons for studying cataphors are thus their status as natural language phenomena, their relation to anaphoric structures, and their role in potentially undermining or strengthening the Principle of Compositionality.

As it was mentioned earlier, scholarly works with a formal analysis of cataphors are not numerous. Two important studies on the subject are those of Gennaro Chierchia (1995) and Ronnie Cann and Catriona McPherson (1999). Chierchia (1995) devotes a chapter to related structures entitled "Extensions: Reconstruction, Topicalization, and Crossover" in *Dynamics of Meaning: Anaphora, Presupposition, and the Theory of Grammar*, incorporating them in his system of Dynamic Binding. His theory is a development of dynamic Discourse Representation Theory (DRT (Kamp, 1981), File Change Semantics or FCS (Heim, 1982)) "recast … in a version of Montague's Intensional Logic" (Chierchia, 1995, p. 78).

Cann and McPherson also opt for a DRT analysis in their unpublished manuscript "Interclausal Cataphora in English". They discuss at length the possible structures in which cataphors can occur; however, they admit that save for "small pilot tests", they conducted no serious empirical research to determine the acceptability of their example sentences (Cann and McPherson, 1999, p. 15).

Other works on cataphora include Silvia Bruti's paper "Cataphoric complexity in Spoken English", which is a corpus-based exploratory study in *Discourse Patterns in Spoken and Written Corpora* (2004), Guy Carden's "Backwards Anaphora in Discourse Context" (1982), Valentina Binachi's "A Note on Backward Anaphora" (2010), and an experimental

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[3] Named after logician Gottlob Frege. On the contextuality versus compositionality principle controversy, see Hans Rott's "Fregean Elucidations" (1999).

study by Nina Kazanina, et al. "The effect of syntactic constraints on the processing of backwards anaphora", published in 2007.

Unlike cataphora, anaphora has been the subject of study in the fields of syntax and semantics for a long period of time, and—being well-studied—it has been tested in a number of theoretical frameworks. In syntactic theory, there are solutions for anaphora resolution already in Government and Binding Theory and later in the Minimalist Program. In semantics and logic, Richard Montague had a significant role in laying down the foundations of what is today the formal study of meaning. Embracing the Principle of Compositionality, he developed a tool for the representation of natural language in logic, which logicians and linguists later built on to propose their own treatment of anaphoric structures.

As mentioned earlier, donkey sentences received much of the attention. Besides the Discourse Representation Theoretical handlings of these structures, another route emerged in dynamic semantics. An important step, Dynamic Predicate Logic, was developed in Groenendijk and Stokhof (1991) and further improved with the addition of ideas from update semantics in Groenendijk, Stokhof, and Veltman (1996). DPL offers a compositional treatment of discourse, including structures with donkey anaphors.[4]

At the very beginning of their 1991 paper, Groenendijk and Stokhof state that "no attempts are made to improve on existing theories empirically" (p.1). That being the case, they do not expand the number or nature of the linguistic phenomena to be examined, leaving thus far neglected structures, such as interclausal and inter-sentential cataphora, untouched. This is the point at which the current study joins in on the conversation.

Two alternative analyses are offered for the treatment of cataphors within the slightly modified dynamic semantic framework of Groenendijk, Stokhof, and Veltman (1996). The

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[4] They emphasize that compositionality is a methodological principle, not a cognitive or empirical one (Groenendijk and Stokhof, 1991, p.1).

first one proposes an alternative handling of free variables in a given discourse context, asserting that, despite of what the 1996 framework suggests, variables introduce a discourse referent of their own when no other referent is available for them to be associated with. The details of this route are worked out in subsection 5.2.2.1. The second route introduces a minor change in making the referent system a two-sorted one. Rendered thus, the referent system is the union of active discourse referents and the newly introduced system of interim pegs, which work as transient discourse referents introduced by free variables. This route is detailed in subsection 5.2.2.2. Sample analyses follow these two subsections in 5.2.2.3.

The aim of this study is thus to propose a treatment of structures containing cataphora within the framework of dynamic semantics as developed in the works of Jeroen Groenendijk, Martin Stokhof and Frank Veltman. In order to conduct a thorough study on cataphors, however, it is important first to consider the existing literature on anaphors as well as cataphors, including studies in the DRT tradition and other semantic frameworks, which will be the subject of section 3 and section 4 respectively—after the introduction of the problem in more detail in section 2. Section 5 introduces the proposed analyses of cataphoric structures. The last section concludes the study.

Throughout the study, I tried to use examples of utterances that are original in the sense that either they were collected from real-life conversations over the past two years (2014-2015), or from other studies that worked with real-life instances. Other examples are short excerpts from literary works. Despite these efforts, some of the sentences remain textbook examples (collected from Groenendijk & Stokhof's, Chierchia's and Cann & McPherson's works). To provide an acceptable empirical basis, however, all of the sentences have been evaluated with the help of eleven native speakers of English (all of whom are from the United States of America, holding a university degree or currently working on acquiring

one). As they are pragmatically different in nature, I did not include the literary examples in the sentences to be evaluated.

2.   Cataphors: Preliminaries

After the brief introduction above, this section develops the problem of cataphors further by briefly examining other fields of linguistics that semantics interacts with. It is important to explore and introduce these as well, especially as different levels of linguistic representation contribute differently to meaning. One such field is pragmatics, which studies meaning as it manifests itself in (human) interaction. The next area is the syntax-semantics interface: the pressing question regarding the status and nature of LF, a syntactic level, which according to some theories provides semantics with input. The discussion of Logical Form leads to the last section, which concludes with a closer look at the semantic side of the coin with compositionality in focus.

2.1 The Semantics-Pragmatics Interface

The traditional view of the division of labor between pragmatics and semantics is that the latter looks at *invariable* meaning, whereas the former has meaning *in context* as its subject matter. This view, however, can be challenged on multiple grounds, and theorists are still trying to define the line between the two.

Isidora Stojanovic (2007) formulates the three main criteria for this distinction as follows:

(i)   ("lexical encoding"): Semantics deals with elements that are lexically encoded in the meaning of the words, pragmatics deals with elements that are not lexically encoded;

(ii)   ("context-independence"): Semantics deals only with elements whose meaning does not depend on any contextual factors; elements that depend on context belong to pragmatics;

(iii)   ("truth-conditionality"): Semantics deals with elements that bear upon truth and truth conditions; pragmatics deals with elements that go beyond truth conditions, such as implicatures. ("The semantics/pragmatics distinction" p. 317)

Despite their revelatory appeal, Stojanovic admits that these criteria do not make a clear distinction between semantics and pragmatics, pointing out, for instance, that they fail to place the study of indexicals satisfactorily within one field or another (ii). (Stojanovic, 2007, p. 318) It is also unclear what can and cannot count as lexically encoded information (i), and where the study of metaphorical meaning or presuppositions would fall under these criteria. Also, the criteria are those of a static semantics (iii), which is of course not a problem in itself; however, as such, they go against the dynamic definition of meaning as "context change potential" (or CCP). A definition that is a stepping-stone in accounting for the donkey pronouns mentioned earlier in the introduction, CCP is a notion with much potential in exploring and explaining further linguistic phenomena—including cataphoric structures. Depending on one's theoretical inclinations, therefore, a set of static criteria may not be acceptable.

Operating with a somewhat blurred line between pragmatics and semantics is not without consequences, especially regarding terminology. In her 2010 article, "A note on backward anaphora", Valentina Bianchi emphasizes the importance of maintaining a proper distinction between what one calls anaphora in semantics and in pragmatics. Going back to Tanya Reinhart's explanation of separating "binding" and "co-reference", she distinguishes between "semantic anaphors" c-commanded by their antecedents, and "discourse anaphors" with "accidental coreference". The claim is that the former belongs to semantics proper, while the latter is a pragmatic matter (Bianchi, 2010, p. 2).

Bianchi's distinction appears to be clear enough, however, there are examples where the difference is obscured to a certain extent. One might want to consider the standard sequence of sentences with inter-sentential anaphora in dynamic semantics: "A man walks in the park. He whistles." (Groenendijk, J. and Martin Stokhof, 1991 p. 2). This case appears to be that of a discourse anaphor, where the pronoun in the second sentence co-refers with the noun phrase in the first sentence, however, as the noun phrase is indefinite, it fails to pick out an individual in the domain of discourse. In the dynamic semantic tradition, the pronoun is also understood to be *semantically* bound by the DP with an indefinite article, which is translated as an existential quantifier, dynamically binding the pronoun outside of its *syntactic* scope. Maybe it is only a relationship of some sort of coreference (the nature of which is uncertain), but if semantics can account for it, why exclude these instances of anaphora (and cataphora) based on a purely syntactic notion?[5] One can make the distinction; however, the tools developed in dynamic semantics are strong enough to tackle issues that may fall on the pragmatic side of this divide.

As is the case of anaphors, cataphors also appear in various structures. Some (1) belong to the semantic type, others to the pragmatic type (2). Some (3) are similar to the dynamically bound example above.

1)   If it$_i$ is overcooked, [a hamburger]$_i$ usually doesn't taste good. (Chierchia, 1995, p. 129)

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[5] Is should also be noted that traditionally, as it is pointed out in Newson, M. (2014), *reference* is a semantic notion to begin with. (p. 3) This is not to say that the co-occurrence of syntactic binding and semantic coreference is rendered unimportant in determining what semantic and pragmatic anaphors and cataphors are, but despite the practice of regarding coreference somehow dependent on syntactic binding, it might have its merits to consider it as a standalone phenomenon.

A point in case is DPL, where semantic scope does not equal syntactic scope, and "syntactically" bound examples are treated the same as cases of coreference.

2)   He_i made me laugh. He_i made me cry. Robin Williams_i was the greatest.

3)   It_i was ugly. It_i was dirty. [A cheap hostel]_i is never a good choice.

And as with anaphors, the question here also arises whether it is well-advised to analyze them all as "semantic" phenomena. (1) seems to be the most obvious choice for semantic analysis, however, it is not certain that (2) and especially (3) are not cases of binding in the dynamic semantic sense.

By other definitions, pragmatics as meaning in context maintains that context and utterance codetermine each other (Thomas, 1995). An utterance gains its full interpretation in context, and that same context is changed, developed further, by the addition of the utterance. In this sense, meaning as CCP comes closer to pragmatics than the traditional truth-conditional understanding of the notion. For this reason, it might prove to be fruitful to include instances of cataphora that are not strictly speaking "semantic" (in Reinhart's and Bianchi's sense of the word).

2.2 The Syntax-Semantics Interface

At the root of the problem is the undetermined relationship between syntax and semantics: by Reinhart's (and Bianchi's) definition, the difference between semantic and pragmatic cases of anaphors (and by extension, cataphors) appears to be syntactic. Robert May (1985) emphasizes that matters of use go beyond grammar and Jenny Thomas (1995) stresses that "meaning potential" alone is not enough:

> Which construal or construals will be preferred on a given occasion of use is a matter
> that goes beyond grammar per se, taking into account various properties of discourse,
> shared knowledge of the interlocutors, plausibility of description, etc. To conflate
> these matters would be to confuse the grammatical issue—to what degree a sentence's
> structure fixes its meaning—with an issue ultimately of use. (May, 1985, p. 14-15)

 (…) meaning is not something which is inherent in the words alone, nor is it produced

by the speaker alone, nor by the hearer alone. Making meaning is a dynamic process,

involving the negotiation of meaning between speaker and hearer, the context of

utterance (physical, social and linguistic) and the meaning potential of an utterance.

(Thomas, 1995, p. 22)

May is on the syntax-LF side, claiming that LF is a representation of meaning fixed in

structure (as accurately as LF can achieve this), and it does not need to be anything more than

that, lest one might confuse grammar and use. Thomas explains the view of meaning as

meaning potential (the interpretation of LF) plus contextual information. Understood this way,

the role of semantics is the interpretation of LF, the outcome of which process is to be handed

over to pragmatics. However, while information is read off logical form, semantics need not

necessarily take syntactic (LF) information as input exclusively, especially when equipped

with the expressive power of dynamic semantic tools. Defining meaning as Context Change

Potential might be a starting point in dissolving the discrepancy between a strictly LF-based

and a more contextually enriched take on semantics.

Although the formula of "LF+context=meaning" appears to be straightforward, views

on logical form are not uniform and the relationship between syntax and semantics is not self-

explanatory. May's proposal is that LF is a level of representation with S-structure[6] as its

input. His theory is rooted in Chomsky's *Syntactic Structures*:

Logical Form, in the sense to be developed, will then simply be that level of

representation which interfaces the theories of linguistic form and interpretation. On

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[6] S-Structure: surface structure in transformational generative grammar: ". . . let us suppose that

representations at LF are derived by rules having S-structure representations as their input, so that the core levels

of representation are as depicted in (1), constituting the syntactic component of what has been called 'sentence

grammar'

(1) D-Structure—S-Structure—Logical Form" (May, 1985, p. 4)

this view, it represents whatever properties of syntactic form are relevant to semantic interpretation—those aspects of semantic structure that are expressed syntactically. Succinctly, the contribution of grammar to meaning. (May, 1985, p 2)

While discussing inferences, May establishes that "LF does not represent contextually assigned values of indexical elements . . . matters that transcend the grammatical" (p 16). As such, May's LF does not aim to account for inter-sentential cataphors, which fall on the pragmatic side of Bianchi's division. A sequence, such as (3) above *It$_i$ was ugly. It$_i$ was dirty. [A cheap hostel]$_i$ is never a good choice.* cannot be properly represented at LF, since Quantifier Raising[7] is considered clause-bounded (Lasnik and Uriagereka, 2005, p 187). This LF can represent standalone sentences outside of context (which is precisely what it intends to accomplish), but in this form it is insufficient to represent discourse anaphors and cataphors. At LF, an inter-sentential cataphor will not be represented as a bound variable (since by May's definition, "a pronoun is a bound variable only if it is within the scope of a coindexed quantifier phrase" (1985, p 21)), even though in a dynamic semantic framework it can be interpreted as such, as in the DPL system, syntactic and semantic scope need not coincide.[8]

As a syntactic level of representation, LF can differ from one syntactic framework to another, and under certain assumptions, it can also be omitted entirely or be construed of very differently. Pauline Jacobson (2014) lists some logically possible variations of the syntax-semantics interface: syntax and semantics can proceed simultaneously, or (as is assumed in GB and Minimalism) syntax can compute the input for semantics by providing a level of representation. This level can be the surface structure, or it can be an abstract LF (much like

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[7] QR is an LF movement that moves a quantified phrase to such a position where the quantified-over element can properly be bound by the quantifier. May considers LF movements instances of "Move α", the generic name for movement in the GB tradition that he provides "free" application for at LF (1985, p. 99).

[8] An existential quantifier interpreted dynamically can bind a variable outside of its syntactic scope. Cross-sentential binding for anaphors is illustrated in section 3.3.2.

in May's 1985 account). On the interpretation side then, it is theory-dependent whether the surface or the LF representation is interpreted in the chosen semantic framework. (Jacobson, 2014, p. 107-112)

There are still other possible proposals. For instance, in his recently published study, Terje Lohndal proposes a syntax in the tradition of the Minimalist Program[9] that "transparently maps onto semantics, where transparency really means transparency in the spirit of Montague (1974b)" (Lohndal, 2014, p 1). Lohndal advocates a Neo-Davidsonian framework of semantics, working with event structures in the logical form, where each Spell-Out after a derivational process in syntax corresponds to an instance of conjunction, while maintaining that "no semantic information is available in the syntax" (p 2-17, p16). Although Lohndal is working within a version of the Minimalist framework, his idea of logical form departs from the traditional construal, while still aiming at being compatible with a Montagovian (therefore, compositional) account of semantics.

With such different views on how Logical Form is arrived at (if at all), and what it looks like, it is difficult to understand the exact nature of the contribution of syntax to semantics.[10] Circling back to cataphors: it is not always clear how the input to their semantic interpretation differs from one theory to the other—especially since some theories propose LF operations such as Quantifier Raising and Reconstruction,[11] while others might opt for a solution without an LF level, working with the surface representation, thus leaving cataphors in situ. Such a composition then leaves open the possibility of analyzing cataphors in new ways, potentially introducing a semantic representation that is structure-preserving to a certain

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[9] or Minimalism

[10] Lohndal (2014) mentions earlier theories such as Lakoff (1971): ". . . it was assumed that a given meaning (deep structure for generative semanticists) was the input to the syntax" (p. 5), a view where meaning informs syntax.

[11] As in Chierchia's (1995).

extent (in the sense that the order of the pronoun-antecedent sequence remains untouched) and that might have the potential to pave the way for a slightly simpler transition from semantics to pragmatics.

2.3 Compositionality

Matters of LF briefly reviewed in the previous subsection are closely connected to the principle of compositionality. In the introduction to *The Oxford Handbook of Compositionality* (2012), editors Wolfram Hinzen, Marcus Werning, and Edouard Machery summarize the issue as follows:

> Although compositionality is very widely assumed as a constraint for this relationship [between meaning and structure], linguists and philosophers have fundamentally disagreed on whether the principle is empirically valid, and in what form it can be maintained. *Direct Compositionality* (DC) in the sense of **Jacobson**, in particular, wants to set a 'gold standard' for what this relationship is like: this standard is that the mapping of syntactic form to semantic content exploits no 'hidden' level of syntactic representation from which semantic interpretation is read off . . . . Instead, semantics reads off interpretations from the surface form of expressions directly: these (and potentially the context of use) provide all the information that is required. (p. 3)

The original motivation for proposing the principle may have been based on empirical grounds, and some linguists (for instance, Lohndal, quoting Dowty (2014, p. 138)) maintain this today; however, compositionality as presented in Janssen (1997) is a methodological principle, without bearings of an empirical nature. This is also the sense in which Groenendijk & Stokhof's (1991) Dynamic Predicate Logic remains compositional, and the sense in which it is adopted in this paper.

The next two sections discuss issues of anaphoric structures, a subject that has been very prominent in the past few decades, and cataphoric structures, a largely neglected area. As

these pronouns are assigned value by their antecedents, that is, contextually, they are of interest to the study of compositionality.

3.   Anaphors

As it is stated in the introduction, in order to have a comprehensive view of cataphors, it is important to first look at the reverse structure of anaphors, that has a much more extensive literature not only in the field of semantics, but also in syntax and pragmatics. Being such a well-researched phenomenon, the study of anaphors provides crucial insight to the study of cataphors. After a general introduction, this section focuses on the problematic areas of anaphors and the most prominent frameworks that propose different solutions to these problems: Hans Kamp's Discourse Representation Theory (1981) (and in the broader sense of DRT, Irene Heim's independently developed system of File Change Semantics (1982)), and Groenendijk and Stokhof's Dynamic Predicate Logic (1991) (dynamic semantics).

3.1 The "Basic Pattern"

In her 1987 work, *Discourse Structure and Anaphora: Written and conversational English*, Barbara A. Fox considers two modes of description: "context-determines-use" and "use-accomplishes-context"; these two modes work together to create continuous interaction (p. 16). This approach resembles a dynamic semantic view, where the meaning of elements, or at least their interpretation, is given in context, but they also alter that context by adding their own content to it. Fox also rejects the then-traditional view of anaphors that puts emphasis on distance, because according to her it cannot account "for a critical portion of the data" (p. 18).

In her conversational analysis-style treatment of anaphors, Fox makes a distinction between unmarked and marked uses of anaphora: the former are what she calls the "basic patterns" with three subcomponents defined as follows:

1. The first mention of a referent in a sequence is done with a full NP.

2. After the first mention of a referent, a pronoun is used to display an understanding of the sequence as not yet closed.

3. A full NP is used to display an understanding of the preceding sequence containing other mentions of the same referent as closed (p. 17).

In her understanding of "marked" uses of anaphora (under which category cataphors fall), these occur when one of the interlocutors is "doing something special interactionally" (p. 17).[12] Thus, the basic pattern has a neutral standing in that the antecedent-anaphor sequence is more natural than the reverse cataphoric structure.

Fox uses the expression "basic pattern" for pronominal and reflexive anaphors[13], but this terminology can be extended to include every antecedent-anaphor sequence that appears in this order. The pronominal type of anaphora that Fox (1987) focuses on is type (1) in Partee's (2008) list.[14] [15]

(1)   *Neil* went to the post office, because *he* had to pay the bills.

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[12] Understood this way, cataphors are "pragmatic structures" with a distinct illocutionary force. To say that their syntactic structure determines their use would be far-fetched, but the order in which information is presented could be considered a structure in which this illocutionary force is manifested. Furthermore, in Lycan (2000), it is stated that "every utterance has a performative aspect or illocutionary force, which determines the type of speech act performed, and virtually every utterance has a descriptive or propositional content as well" (p. 144). Therefore, an illocutionary force-based argument against cataphors is not a very strong one.

[13] Here, the term "anaphora" includes both pronominals and reflexives, as opposed to its narrower sense in the Chomskyan syntactic tradition.

[14] Coreferential elements are in italics.

[15] Other types in Partee's listing include the following: sentential (1), adjectival (2), VP-anaphora (3):

(1)   *Patrick might get here early*. If *so*, we should be ready.

(2)   Some *inconsiderate* neighbor has been drilling for months without notice. *Such* people make me angry.

(3)   Harris *read that book* because Karen *did*. (p. 1)

Another type of anaphora is what Jeffrey C. King (2013)[16] calls "problematic": (cross-sentential) pronominal anaphora with a quantified NP antecedent.

(2)   *No one* tweeted about *his* day out in the city.

(3)   *Few professors* came to the party. *They* had a good time. (King (2013))

The most straightforward case seems to be type (1), the proper name-pronoun sequence; however, combined with a VP-anaphora, it can become ambiguous (at least when taken out of context, i.e. disregarding the preferred reading given a certain situation):

(4)   Neil read his book, and Karen did too.

Here, having a pronoun in the second conjunct would clear out some of the ambiguity, but even provided that the gender feature[17] is the same, the sentence could still be an example of deictic use. As such, however, it would more of a pragmatic matter, as it would have to do with extra-linguistic context and salience. Partee (2008) groups deictic uses together with examples like (1), and its cross-sentential variety as instances of "pragmatic anaphora" (p. 4). Contextually salient deictically used pronouns and referential elements (such as proper names) are clear-cut cases under this grouping and do not require any special semantic treatment, unlike those discussed in the following subsections.

In any case, these types can all be considered to have a "basic pattern" as they maintain the more natural order of the antecedent-anaphor sequence.

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[16] The latest (2013) edition of the article on anaphors in The Stanford Encyclopedia of Philosophy was last substantially modified in 2005.

[17] $Neil_i$ read his_i book, and Karen read his_i book too.

$Neil_i$ read his_j book, and Karen read his_j book too.

$Neil_i$ read his_i book, and $Karen_j$ read her_j book too.

3.2 Discrepancy in the Basic Pattern

Partee (2008) claims that 'every theory has to have something to say about the basic differences between "coreferential anaphora" and "bound variable anaphora"' (p. 4). However, as it was discussed in the previous section, being a pragmatically "basic pattern" does not entail or guarantee semantic uniformity or an easy division. There are questions of referentiality, coreference, binding (syntactic, semantic, both syntactic and semantic, or just semantic) that need to be answered before one can take a theoretical stand. The following types of anaphora are those that King (2013) labels "problematic" as they do not fit into the two classes unequivocally.

One discrepancy arises in the case of indefinite noun phrases that antecede a pronoun. Here, the problem is that indefinite noun phrases cannot indisputably be represented the same as referential elements, since they generally do not pick out an individual and fix the reference of anaphors as, for instance, proper names do.

(5)   *A kid* is happy when *he* meets *his* hero.

(6)   *Jim* was happy when *he* met *his* childhood hero. (These two examples were

        inspired by King (2013).)

Sentence (8) has a sense of generality[18] as opposed to the specific individual referred to in sentence (9).

What complicates the problem further is when there is a genuine sentence boundary between the noun phrase and the anaphor (10).

(7) *A man* broke into Sarah's apartment. Scott believes[19] *he* came in the window. (King,

        2013)

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[18] This generality can be construed of as the indefinite noun phrase having universal force.

In these cases of cross-sentential anaphora, or discourse anaphora, where syntactic binding does not occur, the relationship between antecedent and anaphoric element is even less straightforward. It is usually not taken to be a case of coreference for the aforementioned reason, but it is also not well-suited to be an antecedent-bound variable pair. The reason for this lies in its cross-sentential structure: however one interprets the noun phrase (translating it with an existential or a universal quantifier), in traditional (i.e. static) frameworks, quantifiers cannot bind elements outside of their syntactic scope.

Donkey anaphors are another problematic type. King (2013) distinguishes between two subtypes: conditional (8) and relative clause (9) donkey sentences.

(8) If a farmer$_i$ owns a donkey$_j$, he$_i$ beats it$_j$.

(9) Every farmer who owns a donkey$_j$ beats it$_j$.

He summarizes the problem at hand as follows (the sentences are renumbered):

On the readings we are concerned with, neither (8) nor (9) is talking about any particular donkey, and so the pronoun 'it' cannot be a term referring to a particular donkey. Further, in the case of (11), all independent evidence available suggests that a quantifier cannot take wide scope over a conditional and bind variables in its consequent (King, 2013).

In recent semantic theory, linguists and logicians gave a lot of attention to these types of anaphors.

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[19] Although *believes* makes the statement an intensional one, is it added in order to show that the identity of the referent of *he* is unknown. It is *whoever* broke into Sarah's apartment that Scott believes to have come through the window.

3.3 Proposed solutions

3.3.1   Discourse Representation Theory

In their introductory article of DRT, Bart Geurts, David I. Beaver, and Emar Maier characterize DRT as a mentalist, representationalist, and non-compositional theory of interpretation, the vantage point of which is that it is capable of representing discourse as opposed to representing single sentences in isolation (2016[20]). It is called mentalist and representationalist, because it introduces a new level of mental representation: discourse representation structures, or DRSs for short, which represent the hearer's interpretation of the discourse. As for the issue of compositionality, opinions differ. In its 1981 formulation, DRT was not meant to be compositional, but in its 1997 formulation, van Eijck and Kamp (1997) insist on it having the capacity of being compositional, as much as the language of "standard predicate logic" does[21] (p. 195).

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[20] The article in the Spring 2016 edition has last been substantially modified in 2015.

[21] "The difference between first order logic and basic DRT has nothing to do with expressive power but resides entirely in the different way in which DRT handles context" (van Eijck & Kamp, p. 194). "Standard predicate logic" (by which the authors mean FOL) is not compositional when it comes to representing natural language discourse. The *language* of FOL is built compositionally, but it is not designed to handle natural language. It lacks the expressive power to represent elements of discourse such as cross-sentential anaphoric relations, which is one of the reasons why dynamic predicate logic was developed:

> *A man walks in the park. He whistles.* (from Groenendijk & Stokhof, 1991)

> a) $\exists x \ (\text{man}(x) \land \text{walk}(x)) \land \text{whistle}(x)$

> b) $\exists x \ (\text{man}(x) \land \text{walk}(x) \land \text{whistle}(x))$

A set of reference markers[22] (universe), and a set of conditions (atoms, links, or complex conditions) constitute DRSs. The general points of the 1997 formulation are the following:

i)   The reference markers in the universe of a DRS all get an existential interpretation;

ii)   All reference markers in the universe of a context DRS are available as anaphoric antecedents to pronouns and other anaphoric expressions that are interpreted within this context;

iii)   The interpretation of a sentence S in the context provided by a DRS K results in a new DRS K', which captures not only the content represented by K, but also the content of S, as interpreted with respect to K (van Eijck & Kamp, 1997, p. 185)

In DRT, indefinite noun phrases are treated as novel expressions, and as such, they introduce reference markers, which means that by point (i), they get an existential reading ("existential closure".) By (ii) and (iii), if an indefinite NP antecedent is represented in the matrix universe (by a reference marker), it is accessible for subsequent sentences which are part of the discourse and are interpreted in the context of the first, thus making anaphoric connections possible.

For instance, (10) represents S2 in the context of S1, which contains an indefinite noun phrase. That NP introduces a reference marker, which is available as antecedent for the pronoun in S2 (as S2 is interpreted in the context of S1.) The equation condition expresses the link between the two reference markers (van Eijck & Kamp, 1997, p. 185).

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[22] "Reference markers" in the van Eijck & Kamp chapter, and "discourse referents" in the article by Geurts, Beaver, and Maier designate the same type of linguistic components.

(10)   (S1) *A man* walks in the park. (S2) *He* whistles. (Groenendijk & Stokhof, 1991,

p. 2)

$$
\begin{array}{|l|}
\hline
x\ y \\
\hline
\text{man } x \\
\text{walk-in-the-park } x \\
y = x \\
\text{whistle } y \\
\\
\\
\hline
\end{array}
$$

As for the representation of the interpretation of donkey anaphora, it is crucial for

DRT to be able to provide some representation that accurately captures the universal force of

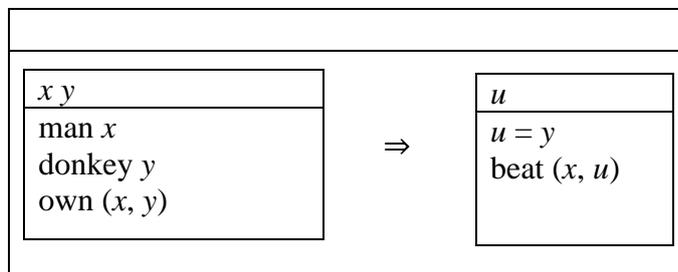the antecedent indefinite noun phrase. Take for example the following conditional sentence:

(11)   If a man walks in the park, he whistles.

$$
\begin{array}{|ll|}
\hline
\begin{array}{|l|}
\hline
x \\
\hline
\text{man } x \\
\text{walk-in-the-park } x \\
\\
\hline
\end{array}
& \Rightarrow \quad
\begin{array}{|l|}
\hline
\\
\hline
\text{whistle } x \\
\\
\hline
\end{array} \\
\hline
\end{array}
$$

In DRT, the general rule is that reference markers get an existential interpretation. However,

van Eijck & Kamp (1997) point out the following about this principle: "[it] applies to the

reference markers in the main DRS universe. The logic of reference markers in subordinate

universes . . . is determined by the principles governing the complex DRS conditions to which

they belong" (p. 186). A conditional makes for a complex condition, $K \Rightarrow K'$, with the

interpretation that whatever satisfies K also satisfies K'. In other words, for every man that

walks in the park (satisfying $\{\{x\}\{\text{man}(x), \text{walk-in-the-park}(x)\}\}$), it will be true that he

whistles (satisfying $\{\text{whistle}(x)\}$), which gives a universal interpretation.

The representation of donkey-sentences is very similar. Sentence (8) is repeated here as (12) from the previous section.

(12)   If a farmer owns a donkey, he beats it.

$$
\begin{array}{|l|}
\hline
\\
\begin{array}{|l|}
\hline
x\ y \\
\hline
\text{man } x \\
\text{donkey } y \\
\text{own } (x,\ y) \\
\hline
\end{array}
\quad \Rightarrow \quad
\begin{array}{|l|}
\hline
u \\
\hline
u = y \\
\text{beat } (x,\ u) \\
\hline
\end{array}
\\
\\
\hline
\end{array}
$$

Sentences such as (13) are represented similarly.

(13)   Every man walks (van Eijck & Kamp, 1997, p. 222).

$$\{\{x\}\{man(x)\} \Rightarrow \{walk(x)\}\}$$

Of such structures, van Eijck & Kamp (1997) say the following:

> . . . a universal quantifying NP imposes a conditional connection between its own descriptive content and the information expressed by the predication in which it participates as argument phrase; and this connection is interpreted in the same way as the ⇒-condition that the theory uses to represent conditional sentences (p. 187).

However, for quantified donkey-type sentences (which quantify over classes[23]), such as (14) and (15), van Eijck and Kamp propose a different solution that makes use of notions such as renaming[24] (of variables), merge[25] (of DRSs), and a generalized quantifier operator[26].

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[23] Classifying over sets is an operation that is not available in FOL. Generalized quantifiers are available in FO(Q) (Westerståhl, 2011, ed. 2015)

[24] Renaming: 215-222. Note that DRT does not claim to be a theory of anaphora *resolution* (van Eijck & Kamp, 1997, p.221-222).

[25] Merge operations: pp. 204-215

[26] Quantification: pp. 222-225

(14)   Most men who meet a nice woman smile at her. (1997, pp. 223)

MOST x {{y}{man(x), woman(y), nice(y), meet(x,y)}{$\underline{z}$}{z=x, smile-at(x,z)}}

(15)   Every man who meets a nice woman, smiles at her. (1997, pp. 222)

EVERY x{{y}{man(x), woman(y), nice(y), meet(x,y)}{$\underline{z}$}{z=y, smile-at(x,z)}}

K($\forall x$)K'

The authors explain that the two variables (x and y) have different roles, with x being a

"variable bound by the quantifier": "the role played by x . . . is special in that it is x . . . which

determines between which sets the generalized quantifier relation expressed by the determiner

of the quantifying NP can be said to hold" (1997, p. 223).

The ways in which the DRT treatment handles the discrepancies in the "basic pattern"

are the following: (i) default existential interpretation of novel reference markers, (ii)

universal reading encoded in the conditional, and (iii) generalized quantifiers for quantified

donkey-type sentences.

3.3.2 Dynamic Predicate Logic

As emphasized in Groenendijk & Stokhof (1991), DPL is a non-representational and

compositional[27] system of discourse semantics (p. 1), whose dynamicity first lies in its

construal of meaning as "context change potential" (p. 4). DPL works similarly to the

denotational semantics of programming languages, and meaning is understood to be the

relationship between states: $\langle g, h \rangle \in |\pi|$ iff $h[x]g$ – meaning that the ordered pair of

assignments g (input) and h (output) is in the interpretation of program/state π if and only if h

differs from g at most in its value assignment for x (p. 5-6).

In DPL, existential quantification and conjunction are internally and externally

dynamic, which guarantees that the existential quantifier can bind outside of its syntactic

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[27] Again, compositionality here is understood to be a methodological principle.

scope and conjunction can ensure that the value of the variable is transmitted to the second conjunct.

Interpretation of ∃-quantification: $|\exists x\Phi| = \{\langle g,h\rangle \mid \exists k: k[x]g \wedge \langle k,h\rangle \in |\Phi|\}$

Interpretation of conjunction: $|\Phi \mathbin{\&} \Psi| = \{\langle g,h\rangle \mid \exists k: \langle g,k\rangle \in |\Phi| \wedge \langle k,h\rangle \in |\Psi|\}$

From this follows the equivalence relation in (R1), which accounts for sentences with an indefinite NP antecedent followed by a discourse anaphor, like (11) in the previous subsection and shows how in DPL, binding is not necessarily restricted to the syntactic scope of the quantifier.

(R1) $\exists xPx \wedge Qx \Leftrightarrow \exists x(Px \wedge Qx)$ (p. 6-9)

Interpretation of existential quantification and conjunction:

$|\exists xPx \wedge Qx| = \{\langle g,h\rangle \mid \exists k: \langle g,k\rangle \in |\exists xPx| \wedge \langle k,h\rangle \in |Qx| \} =$

$\{\langle g,h\rangle \mid \exists k: k[x]g \wedge k(x) \in F(P) \wedge h = k \wedge h(x) \in F(Q) =$

$\{\langle g,h\rangle \mid h[x]g \wedge h(x) \in F(P) \wedge h(x) \in F(Q)\}$ (p.8)

As for the interpretation of the conditional, which is key in representing sentences such as (12), DPL says that it is internally dynamic, but externally static (behaving like a test.)

Interpretation of conditionals: $|\Phi \rightarrow \Psi| = \{\langle g,h\rangle \mid h=g \wedge \forall k: \langle h,k\rangle \in |\Phi| \rightarrow \exists j: \langle k,j\rangle \in |\Psi|\}$

"The interpretation of $\Phi \rightarrow \Psi$ accepts an assignment *g* iff every possible output of Φ with respect to *g* leads to a successful interpretation of Ψ, and it rejects *g* otherwise" (p. 10) This is how the antecedent of the conditional has universal force (even though it is translated with an existential quantifier). Its externally static nature is captured in sentences of the following structure: * (S1) *If a farmer owns a donkey, he beats it.* (S2) *He hates it* (p. 10). The pronouns in S2 are blocked from being anaphorically linked to the indefinites in S1[28].

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[28] Groenendijk & Stokhof (1991) provide counterexamples to the apparent lack of dynamicity (see p. 49 of "Dynamic Predicate Logic").

The universal quantifier in sentences like (17) is externally static, that is, it cannot pass on the value of a variable within its syntactic scope to a variable outside of it. *(S1) *Every man walks in the park*. (S2) *He whistles*. Again, the pronoun (variable) in S2 cannot be anaphorically linked to the quantified NP in S1.

Interpretation of ∀-quantification: $|\forall x \Phi| = \{\langle g,h \rangle \mid h=g \wedge \forall k: k[x]h \Rightarrow \exists m: \langle k,m \rangle \in |\Phi|\}$

From the interpretations of existential quantification, implication, and universal quantification, the following equivalence relation holds:

(R2) $\forall x(Px \rightarrow Qx) \Leftrightarrow \exists xPx \rightarrow Qx$ (p.11)

Implication is not externally dynamic, which means that it cannot pass on the value of x regardless of whether it is an internally and externally dynamic existential quantifier, or an internally dynamic, but externally static universal quantifier that binds the variable.

Another operation that blocks dynamicity is negation. DPL (1991) exemplifies this with sentences of the following kind: (S1) *It is not the case that a man walks in the park.* (S2) *He whistles*. and (S1) *No man walks in the park*. (S2) *He whistles*. (p. 12).

Interpretation of negation: $|\neg\Phi| = \{\langle g,h \rangle \mid h = g \wedge \neg\exists k: \langle h,k \rangle \in |\Phi|\}$

Negation tests if Φ can be processed with input assignment g, and if so, it blocks that assignment. Being a test, negation does not let the existential quantifier bind a variable outside of its syntactic scope in $\neg\exists xPx \wedge Qx$.

These formulations make the language of DPL one that can account for the treatment of indefinite noun phrases, different types of donkey sentences, and their anaphorically linked pronouns in a compositional way.

4. Cataphors

After the preliminaries in the second section, and the discussion about the nature and treatment of anaphors in the third section, the fourth section looks at cataphors more closely in light of the previous sections. The subject of subsection 4.1 is the cataphoric aspect of the pragmatics-semantics interface. Subsection 4.2 details remarks on the syntax-semantics interface—specifically on backwards anaphors and the backward coreference domain. Subsection 4.3 briefly presents two solutions for the problem of cataphors that have been proposed within the frameworks of Dynamic Binding (Chierchia, G. (1995)) and Discourse Representation Theory (Cann, R. & McPherson, C. (1999)).

4.1 The Semantics-Pragmatics Interface

At the very beginning of the previous section, Barbara A. Fox's 1987 distinction between marked and unmarked uses of anaphora was imported. The anaphoric examples in the previous section were all instances of unmarked use, making up the "basic pattern" (despite the discrepancies examined in subsection 3.2). This section focuses on one specific kind of marked use, cataphors.

The way they differ from the basic pattern is by using a pronoun as the first mention of a referent, instead of a full NP (Fox, 1987, p. 20). The emphasis here is on "first mention", as more often than not, cataphors in the literature are understood as really being anaphors with an antecedent introduced somewhere in the preceding discourse. While that is the case many a time, it is not unimaginable that sometimes a pronoun is the actual fist mention of some referent[29] (and is therefore a cataphor), clarified later in the discourse. Such were found for instance in Fox's conversational data, although, unfortunately, the example she provides

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[29] In the data Fox works with, 16% of first mentions were pronouns in written text, and 51% in conversations (p. 143, table 6.3).

seems to be that of an indexical use of a pronoun rather than a cataphoric one. The conversation may have provided an actual referent for the pronoun, but the quote only goes as far as the first mention, implying a referent rather than providing one explicitly.

Fox makes the generalization that all first mentions are "evoked by a frame" (p. 67), and are thus contextually salient. She then says the following:

> ". . . the exact identity of the referent seems to be unimportant . . . a pronoun is used when the recipient is incapable of identifying the specific referent, and is in fact not expected even to try to identify the referent. The class of referents is identifiable, however: and it is perhaps this identity which the recipient is being invited to "resolve" by the use of the pronoun (p. 67).

In her examples, context creates certain presuppositions that indicate some referent (or class of referents). Interesting as this point is, it does not seem to cover all instances of first mentions, or lessen the importance of the link between the pronoun and its antecedent in actual cataphoric constructions. The following examples illustrate the difference (for (1), with an indefinite NP antecedent, it is more viable to accept Fox's generalization, in light of (2) and (3), however, which contain R-expression antecedents, it should be rejected.)

(1) *It* was ugly. *It* was dirty. *A cheap hostel* is never a good choice.

(2) *He* made me laugh. *He* made me cry. *Robin Williams* was the greatest.

(3) *She* had a bad fall, but *the girl* didn't give up.

(4) "Did she say *who* did it?" said Dumbledore quietly.

"Oh yes, Professorhead," said Peeves, with the air of one cradling a large bombshell in his arms. "*He* got very angry when she wouldn't let *him* in, you see." Peeves flipped over and grinned at Dumbledore from between his own legs. "Nasty temper *he*'s got, that *Sirius Black*" (Rowling (1999) p. 121).

The first example is more of a generalization of cheap hostels, the exact identity of the hostel the utterer stayed at may be irrelevant for the point he is making. Utterance (2) is different. In this case, context can make the referent salient before the exact name is mentioned, but one cannot claim that the identity of the referent is insignificant in the context in which it appears. (3) and (4) are similar with respect to salience – one might even argue that the first mention is an instance of deictic use, however, a referent is given and is linked to the pronoun. In the data Fox provides, the first mention of a referent is also the only mention (that is, the link is between the pronoun and the extralinguistic context in which it occurs). In the case of *real* cataphors (which are still first mentions), there is an available antecedent (or "postcedent" (Partee, 2008, p.2)) in the linguistic context.

How marked a cataphoric structure is depends on its context. As Silvia Bruti (2004) points out in the conclusion of her corpus-based study, the markedness of cataphors is gradable: "cataphors can in fact be located on an axis of indeterminacy, where empty signs are closer to the negative poles, and items richer in context are placed near the positive pole" (p. 60). Pronouns, as they have very little informational content, are "empty signs" in Bruti's terminology. Some information, however, is grammatically encoded in a cataphoric pronoun:[30] in English, it is information about gender, number, and case. This leads Bruti to the following observations: 1) the closer the antecedent is, the more transparent the cataphor will be, 2) cataphors are less indexical than demonstratives, 3) their interpretation is entirely context-dependent, and 4) they are structurally simple; they have no effect on the information structure (p. 60).

With observations 1 and 3, a question, familiar from the section two, arises again. If the interpretation of cataphors is entirely context-dependent (by observation 3), and distance

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[30] What kind of grammatical information can be encoded in a cataphora is language specific. In English, gender and number are encoded, as well as case (nominative or accusative).

affects transparency (by observation 1), how does one define the domain within which cataphors are not only acceptable, but also representable in semantics in a preferably compositional way? Two closely connected issues are, again, the question of semantic versus discourse anaphoricity (or in this case, cataphoricity), and the question of coreference versus variable binding.

The previous two sections elaborated on these matters mainly in the context of anaphors, but it was noted in the first section that the same issues can be raised in connection with cataphors. In addition to the sentences (1-3), example (1) from section two is repeated here as (4).

(5) If *it* is overcooked, [*a hamburger*] usually doesn't taste good. (Chierchia, 1995, p. 129)

Sentence (5) is parallel to a semantic type of anaphor (a case of binding), sentences (2) and (3) and (4) to a pragmatic type (a case of coreference), and sentence (1) to examples that DRT and DPL are concerned with, as discussed in the previous section (cases of coreference as dynamically bound anaphora). The question at hand is whether one can talk about actual backward coreference, the proposal of which would allow a treatment and representation of cataphors in situ.

4.2 The Syntax-Semantics Interface

At the level of surface structure, cataphors precede their antecedents, thus they cannot be within their scope or binding domain. In syntax, a standard solution to the problem is to treat the structure as that of a hidden anaphora: at some level of syntactic representation, cataphors are moved, copied, reconstructed, or otherwise reverse-engineered back into their supposed original position, where they are in place for proper binding or coreference.

Therefore, by the time the structure is sent off for interpretation to semantics (or the semantics-pragmatics interface)[31], it is cataphoric no more.

It is the notion of c-command, or rather the desire to avoid its violation (Crossover), that motivates this treatment. As it was mentioned in the previous section, since Reinhart, semantic binding has been dependent on syntactic binding, making it ipso facto impossible to interpret cataphors in situ.

While with interclausal cataphors Reconstruction seems viable, it is not clear how cross-sentential cataphors are to be treated. Even if one keeps in mind the different binding versus coreferential relations and regulations discussed in the previous sections, it would still be strange to suppose that although S1 precedes S2, it really comes from a position following S2.

A natural assumption is to say that somewhere in the discourse, there was an available referent for the "cataphoric" (or in this case, anaphoric) pronoun, thus making it contextually salient (much like Fox's indexicals.) However, this is another evasive maneuver, and it fails to account for those instances where a pronoun is an actual first mention with a proper antecedent introduced later in the discourse.

Guy Carden (1982) in "Backwards anaphora in discourse context" addresses the problematic aspects of this approach, which he calls the *Forward-Only Hypothesis* (p. 361). He claims that it cannot account for all data and patterns that emerge in spontaneously produced discourse (p. 362). He found the following:

> . . . over 100 cases where the backwards pronoun is the first mention of the referent in the discourse. In addition, I have found a smaller number of cases where the

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[31] In the frameworks discussed earlier in the first section, syntax always comes before semantics. In some cases, they work simultaneously or sequentially, but the idea of syntax informing semantics is maintained. Issues of LF are discussed in section 2.

backwards pronoun in principle could not have had a referent earlier in the discourse, since the antecedent is indefinite (29 cases) or the pronoun is scoped by an overt quantifier like *each* or *many* (28 cases) or by a generic (30 cases) (p. 362).

To counter the argument that there must first be an antecedent before the pronominal mention of the referent, Carden uses a substitution test to determine which potential noun phrase antecedes the pronoun by first replacing it with NP1 that precedes it and then comparing the result to that of replacing the pronoun with NP2. He finds that in a number of cases NP1 does not work[32], which means that it cannot be the antecedent[33], and as Carden says, it forces one "to adopt an analysis where the coreference runs backwards from NP2" (p. 364).

Some of his examples are first mentions with an R-expression antecedent (proper name or definite NP), others with an indefinite NP antecedent[34]:

(6) After *his* recent election as Republican national chairman, *Bill Brock* said…

(example 8, letter to *The New York Times*, p. 366)

(7) Details of *her* Death Fill the Day

For Family of *the Latest Victim* (example 11 from *NYT* (headline), p. 366)

(8) When *she* was five years old, *a child of my acquaintance* announced a theory

that she was inhabited by rabbits. (example 12 from *NYT*, p. 367)

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[32] Carden (1982) observes three ways an NP1 can fail the test: 1) the discourse becomes ambiguous, 2) the discourse is coherent, but the reference of the pronoun shifts, 3) the reference becomes too vague, resulting in an incoherent discourse (p. 364-365).

[33] One possible objection coming from a dynamic semantic standpoint could be that by the time one reaches the postcedent/antecedent, the context has changed substantially, therefore making the postcedent or antecedent unsuitable for substitution in each case. However, in DPL, it is not truth-conditions that determine meaning to begin with. Carden's argument still stands in Footnote 32 above.

[34] Coreference is indicated in italics.

Carden then provides two alternatives as to what someone advocating the Forward-Only Hypothesis can say when confronted with these data: one option is to suppose that the referent is contextually salient; the other is to discard the data as a "stylistic move".[35] As for the first alternative, according to Carden, there is still data that escapes this route: indefinite NP antecedents, which are generally claimed to introduce a new discourse referent (see e.g. in DRT). Were antecedents contextually salient in all cases, one would not expect to find indefinites in a postcedent position (p. 367). The second alternative, rejecting the data, is also not the best way to proceed: Carden points out that "we want our grammar to account for what people actually say and write" (p. 376).

> It is important to distinguish this proposal, under which non-predictable backwards anaphora is ungrammatical, but occurs because the author wants a special stylistic effect, from an analysis in which non-predictable backwards anaphora is grammatical, and incidentally has some stylistic effect. . . . The crucial question is not, therefore, 'Is there a stylistic effect?', but rather 'Are the examples ungrammatical?' (p. 379).

Grammaticality is thus what is crucial in determining the fate of cataphoric structures. What counts as grammatical is often based on prescriptive judgement, and, unfortunately, in a number of cases, examples are not tested on a satisfactory number of native speakers. Carden, for instance, criticizes Tanya Reinhart for relying solely on her own judgement: only what she "introspects" to be acceptable is grammatical (p. 367). Carden takes a different approach in using performance data (spoken and written), thereby ensuring that his remarks are of real-life discourse patterns (p. 384-386). As such, his examples for pronouns as first mentions constitute a valid point in proving the possibility of backwards coreference and proposing a surface-based semantic analysis that leaves the order of the pronoun and its antecedent intact.

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[35] Fox (1987) expresses similar ideas in connection with the "marked pattern".

The notion of backward coreference is made us of also in Seth A. Minkoff's (2004) "Consciousness, Backward Coreference, and Logophoricity". In the context of reflexives, he proposes *Principle E*, defined as follows: "A free Self-anaphor must corefer with, and be in the backward coreference domain of, an expression whose referent typically possesses consciousness" (p. 488). It is important to note in what ways Principle E differs from traditional binding theoretical principles (such as its Principle A counterpart): on the one hand, it brings into the formal treatment of reflexives the extra-disciplinary concept of consciousness, and on the other, the principle is defined in terms of domains and not c-command relations (p. 490). While *domain* is a notion closer to semantics, Minkoff's definition of backward coreference domain is still defined in terms of syntactic nodes: "X is in the *backward coreference domain* of Y if and only if there exists two nodes, A and B such that B is predicated of A, A dominates X, and B dominates Y" (p. 488).

(9) I put {that picture of herself$_i$}$_A$ {next to Sara$_i$}$_B$ (Minkoff, 2004, p. 486)

(10)*I put {that picture of itself$_i$}$_A$ {next to the Hope diamond$_i$}$_B$ (Minkoff, 2004, p. 486)

What is interesting from the viewpoint of cataphors in general is that Minkoff works with Principle E defined in terms of a backward relation. His treatment is a syntactic one, but one might safely assume that coreference and binding can also be defined thus in a semantic analysis, provided the semantic framework has the expressive power and the necessary tools to do so.

4.3 Proposed Solutions

4.3.1 Reconstruction in Dynamic Binding

In its treatment of cataphoric structures, Chierchia's (1995) is one of those analyses that opt for finding a way to handle these structures as anaphoric thus observing the binding

principles.**36** Among other structures, in *Dynamics of Meaning: Anaphora, Presupposition,*

and the Theory of Grammar, he is concerned with cataphors that are the result of left-adjoined

binding:

(11) If *it* is overcooked, *a hamburger* usually doesn't taste good (p.129).

Chierchia supposes that at some level of syntactic representation, the subordinate clause is

reconstructed into a position where it can be dynamically bound[37] by the operator (*usually*) in

the main clause[38] (p.134). As he explains, ". . . the (possibly null) adverb freely selects scope

by adjoining to it at LF. The restriction is what locally c-commands the Q-adverb. Ordinary

types of movement (NP preposing, extraposition) concur in creating the intended LF" (p.

142). Reconstruction happens back into an IP internal position, where Chierchia supposes the

subordinate clause is topicalized from (p. 145):

(12) When it is hungry, a cat usually meows. (p. 143)

---

[36] Chierchia's system of Dynamic Binding combines and develops DRT and a Montagovian intensional

semantics.

[37] The way Chierchia achieves dynamic binding is by using a placeholder "hook" that gives way for

some following information to be incorporated in the representation.

(a) He$_j$ runs.

(b) run(x_j) (static meaning)

(c) ↑run(x_j) = λp [run(x_j) & p^] (dynamic meaning)

Here, the variable is translated as a discourse marker, the up-arrow in (c) maps the static value to a CCP; the

Lambda-expression acts as a placeholder for incoming text (p. 84). Although it would be interesting to see if one

can use Dynamic Binding to hook information to a proposition containing a cataphoric expression, it would still

violate the binding principles, which Chierchia wishes to obey in his 1995 analysis.

[38] This analysis, then, can account for those structures only that contain a quantificational adverb, such

as *usually*, otherwise there must be another way to represent the binding relations in utterances like *If it is*

overcooked, a hamburger doesn't taste good. As one can see, Chierchia proposes the possibility of a null Q-

adverb.

[When it$_i$ is hungry]$_j$ a cat$_i$ usually [t$_i$ meows] t$_j$

He allows for reconstruction to happen either before LF, as an actual syntactic operation, or at LF: "it is at least conceivable that a syntactic approach might be justified for certain constructions and an interpretive one for other constructions. This is indeed what I will end up proposing" (p. 148).

In any case, Chierchia's approach does not accept the backward relations discussed in the subsection above. However, as it has been pointed out, reconstruction can work for interclausal cataphors, but it is a strange conjecture for cross-sentential occurrences. Supposing cross-sentential cataphors can be construed of as a bound variable-postcedent sequence, Chierchia's proposal is still not equipped to handle these, since one cannot "reconstruct" a whole sentence from its linear/temporal position in a discourse.

4.3.2 Processing Constraint in DRT

The analysis Ronnie Cann and Catriona McPherson propose in their unpublished manuscript, "Interclausal Cataphora in English" (1999) is a DRT-based approach. They build on the 1993 formulation of the theory by Kamp and Reyle, which according to them has an approach to cataphoric resolution[39] (p. 1). Interestingly, their solution for the problematic structure is, again, to reinterpret cataphors as underlying anaphors:

> . . . We show that in general cataphoric pronouns are only permissible where there is
> an accessible antecedent for the pronoun already present in, or reconstructible from,
> the discourse which can be identified with the discourse referent of a potential
> 'antecedent' in a following clause. . . . And provide evidence that apparent
> counterexamples always involve the existence of a prior discourse referent which

---

[39] Despite there being a theory for cataphora *resolution* in the analysis Cann and McPherson work with, in their 1997 work, cited in the previous section, van Eijck and Kamp claim that it is not the goal of Discourse Representation Theory to provide anaphora resolution.

enables the indirect linking of a pronoun to a noun phrase in a subsequent clause (p. 1).

While *in general* this claim is valid, it cannot, as it has been pointed out earlier, account for all cataphoric structures that are real first mentions. Furthermore, by Carden's reasoning (discussed in section 4.2 above), there are cases where one cannot *identify*[40] a discourse referent from earlier discourse with one following the cataphoric pronoun.

There is one structure for which Cann & McPherson allow a first mention analysis: left-adjoined subordinate clauses. However, for the representation of these structures, they propose a change in the processing constraints:

> These facts are accounted for by the postulation of a simple constraint on the processing of clauses, such that each clause is necessarily processed in linear sequence, unless marked as subordinate. In the latter case, either the subordinate clause or the clause on which it is dependent may be processed first, allowing true cataphoric links to be established (p. 1)

One reservation regarding this treatment is that it is unclear how the resulting structures contain "true *cataphoric* links", given that the point of the newly introduced constraint is precisely to allow for cataphors to be processed as anaphoric.

The next section proposes a new analysis of cataphoric structures, abandoning Reconstruction and preserving the order of the cataphor-antecedent sequence, analyzing cataphors as such in a dynamic semantic framework in the Groenendijk, Stokhof & Veltman tradition.

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[40] Either salva veritate or preserving coherence. C.f. footnote 33.

5. Dynamic Semantic Analysis of Cataphors

As it is clear from the previous sections, cataphors have been treated as anaphors that are in an undesirable position. The reconstruction-based analysis of Chierchia (1995), as well as the employment of a delayed processing constraint in Cann & McPherson (1999) attempt to make amends by turning cataphors into anaphors. While their proposed analyses have internal coherence, they appear to ignore the possibility that if online interlocutors in natural language discourse that encounter this linguistic device can interpret it as it is, semantics might be able to represent it. It is important to remember Carden's point emphasized in the previous section: our grammar should account for what people actually say and one should avoid disregarding data for the sake of uniformity. This section thus proposes an analysis that treats cataphors not as a structure derived from anaphors as has been suggested so far in the literature, but as a structure in its own right.

5.1 Excursus: Active Search

A recent study places cataphoras in a different light. Nina Kazanina, et al. (2007) conducted a series of experiments in order to determine to what extent syntactic constraints (such as the Binding Principles, specifically Principle C) affect the processing of cataphors[41]. The authors refer to earlier works that suggested that "backwards anaphora dependencies are processed with a grammatically constrained active search mechanism" (Kazanina et al, 2007, Abstract.) They adopt the notion of "active search" from studies of filler-gap dependencies, suggesting that parsers search "for an antecedent for an unanchored pronoun" (p. 386).[42]

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[41]". . . successful constraint application requires that the parser ignore a candidate at a point where no other is yet available" (p. 388).

[42] The authors also note that it is not a *grammatical* necessity for pronouns to have an antecedent: as indexicals, they can refer to contextually salient referents (p. 386).

It is proposed that such an active search can "construct referential dependencies as soon as an antecedent position can be reliably predicted" (p. 387). That is, upon encountering, for instance, a pronoun in a left-adjoined subordinate clause, hearers anticipate a main clause that provides an antecedent. Unlike anaphors, which trigger a search for a "candidate antecedent" in the 'discourse memory' (retrospective search), cataphors trigger a mechanism that evaluates potential antecedents in subsequent text in succession (prospective search) (p. 388). Consider sentences (1) and (2):

(1) <u>While</u> *his* mother was reading Jane Eyre, *John* prepared dinner.

(2) *His* mother was about to leave, <u>when</u> *John* entered the room.

While in (1), the subordinate clause begins with a reliable predictor (*when*) of an upcoming clause with a possible antecedent, in (2) it is only in the second clause that the hearer encounters one. The authors first state that structural properties trigger the active search mechanism as opposed to the occurrence of an unanchored pronoun, later, however, they suggest based on their findings that the process begins even before there is evidence for a potential upcoming antecedent (c.f. p. 406). Speakers encode that a pronoun is to be linked to some element that is its antecedent ("linking") and they inherit the properties of the referring element during an evaluation process (p. 400).

In the study, this proposal for interclausal cataphoras is not extended to cross-sentential occurrences, where no such signal is present. However, as opposed to reconstruction and delayed processing, an active search mechanism is feasible for these structures as well, due to there being no change in the ordering of the elements, which are in want of an antecedent. While not part of a theory of syntax or semantics per se, the idea of active prospective search in the study can be enlightening for a semantic analysis of cataphors as well, inasmuch as it supports a view of cataphors as triggers for some active involvement in interpretation.

5.2 Dynamic Predicate Logic Meets Update Semantics

This last section explores the possibility of an in situ treatment of cataphors within the Dynamic Semantic tradition. The three seminal works are "Dynamic Predicate Logic" (Groenendijk & Stokhof, 1991), "Defaults in Update Semantics" (Veltman, 1996), and "Coreference and Modality" (Groenendijk, Stokhof, and Veltman, 1996).

Dynamic Predicate Logic and Update Semantics (US) are similar in important ways: both are systems that adhere to methodological compositionality, and they both understand meaning to be the capacity to change either contexts (1991 DPL) or information states (1996 US). They, however, differ in the crucial aspect that Update Semantics makes it possible to keep track not only of all the variables introduced, but also of the order in which they appear. No such referent system is available in the 1991 version of DPL: as they state it in the article, Groenendijk and Stokhof "have restrained from explicitly introducing a notation for occurrences" (p. 18). "Coreference and Modality" develops a framework that is the combination of Groenendijk and Stokhof's and Veltman's separate works. As such, it adopts ideas, like that of a referent system[43] from "Defaults in Update Semantics" while remaining dynamic in nature, claiming that an account of anaphoric relations "requires a mechanism to keep track of the objects talked about and the information gathered about them" (p. 6).

5.2.1 The Framework

The analysis proposed in this section is based on the framework developed in Coreference and Modality (1996). Just as it is in DRT and the 1991 version of DPL, it is the *hearer's* information that it relevant. However, unlike in DRT, where proper names, for instance, are always introduced in the matrix DRS (van Eijck & Kamp, 1997, p. 192), in the updated DPL, although it is assumed that interlocutors are aware of what objects constitute

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[43] Originally developed in Vermeulen's "Update Semantics for propositional texts" (1994),

the discourse domain, it is allowed that the hearer be unaware of the names of these objects.[44]

It is through discourse that interlocutors gain information, thereby eliminating possibilities

that do not fit into the updated context (Groenendijk, Stokhof & Veltman, 1996, p. 6). This

appears to be in line with how active prospective search operates in the case of cataphoric

structures.

The new framework differentiates between information about the world and discourse

information. The former is represented by possible worlds, which are identified with first-

order models consisting of a set of objects, the domain of discourse, and an interpretation

function. The latter "keeps track of what has been talked about" with the use of the

aforementioned referent system (p. 7). When new information comes along (a new item in the

discourse), it is entered into the system by the use of *pegs*, which are unique formal objects

that can keep track of discourse referents[45]. As the authors explain:

> The use of a quantifier $\exists x$ adds the variable x to the variables that are in active use; it
>
> introduces the next peg, and associates the variable x with that peg. This is how
>
> discourse information grows: extending discourse information is adding variables and
>
> pegs, and adjusting the association between them (p. 7-8).

Adding discourse information means updating information states, thus eliminating

assignments that are incompatible with the new information (p. 6-8).

The notions of *possibilities* and *information states* are of importance.

5.2 a) possibilities: "Let *D*, the *domain of discourse*, and *W*, the set of p*ossible worlds*, be two

disjoint non-empty sets. The *possibilities* based on *D* and *W* is the set *I* of triples $\langle r, g, w \rangle$,

---

[44] It should be noted that the new dynamic framework, similarly to DRT, DPL, and US, is not designed

for anaphora *resolution*. While there are certain connectives, such as the negation operator, that inhibit

dynamicity, such restrictions hardly account for all the possible coreference relations, or lack thereof.

[45] As attested in Coreference and Modality, natural numbers are a perfect fit as pegs, because they are

unique and infinite.

where *r* is a referent system; *g* is a function from the range of *r* into *D*; $w \in W$" (p. 10).

Possibilities contain individual constants, variables, and n-place predicates.

5.2 b) information states[46]: "Let *I* be the set of possibilities based on *D* and *W*. The set of

information states based on *I* is the set *S* such that $s \in S$ iff $s \subseteq I$, and $\forall i, i' \in s$: *i* and *i'* have

the same referent system" (p. 10). Again, we may disregard the *W* component. Information

states are subsets of possibilities. They encode information about possible denotations of

expressions, and about possible values of variables.

The definitions of the *update, extension,* and *assignment* are also important for the

forthcoming analysis of cataphors.

5.2 c) update: "Let *r* be a referent system with domain *v* and range *n*.

r[*x/n*] is the referent system *r'* which is like *r*, except that its domain is $v \cup \{x\}$, its range is *n* +

1, and *r'*(*x*) = *n*" (p. 8).

5.2 d) extension: "Let *r* and *r'* be two referent systems with domain *v* and *v'*, and range *n* and

n', respectively.

r' is an *extension* of *r*, $r \leq r'$, iff $v \subseteq v'$; $n \leq n'$; if $x \in v$ then *r*(*x*) = *r'*(*x*) or $n \leq r'(x)$; if $x \notin v$

and $x \in v'$ then $n \leq r'(x)$" (p. 9).

5.2 e) assignment: "Let $I = \langle r, g, w \rangle \in I$; *n* the range of *r*; $d \in D$, $s \in S$.

i. *i*[*x/d*] = $\langle r[x/n], g[n/d], w \rangle$.

ii. *s*[*x/d*] = $\{i[x/d] \mid i \in s\}$" (p. 12).

---

[46] The following four are notable types of information states: *state of ignorance* (*minimal state*, 0: where

all worlds are still possible and there is no discourse information); *initial states* (subsets of the minimal state with

little information about the world, but no available discourse information); the *absurd state* (1, where no possible

world remains), and states of *total information* (where only one possibility is left) (Groenendijk, Stokhof &

Veltman 1996. p. 12-13).

5.2.2 Analysis

In the 1996 DPL framework, information states cannot be successfully updated with expressions containing a semantically free (i.e. antecedentless) variable, which cataphors are traditionally thought to be when left in their original position. The reason such an update fails is that there is no discourse referent (peg) associated with the variable that would be assigned an object against which, in the case of an atomic formula Px, property P can be checked. For this reason, a proper in-situ treatment of cataphors requires certain modifications to the original framework. In the following analysis, two novel, but simple solutions are offered which modify the original system in the following aspects:

1. possible worlds are left out of the semantics, therefore an information state is understood as a tuple $\langle r,G \rangle$, where r is a referent system, and G is a set of variable assignments;

2. r is two-sorted[47]: $r = r_n \cup r_A$;

3. $r +_n x = r \cup \langle n,x \rangle$, where n is the first smallest natural number available in r;

4. $r +_A x = r \cup \langle A,x \rangle$, where A is the first letter not used in r[48];

5. $G[_n x]$ is the cylindrical extension of G in the direction of x;

6. $G[P_n x]$ is the set of all g-s in G such that $g(x)$ is in the extension of P.

5.2.2.1 Route One: No Free Occurrences

The first solution introduces the rule of *no free occurrences*, which states that in a given discourse, every variable that is newly introduced brings about the introduction of a discourse referent (a peg) to the referent system. In addition, once a variable has been added to the referent system, it can be used later on, even if update happens with an existentially

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[47] This definition is specific to the second route in subsection 5.2.2.2.

[48] This definition is also specific to the second route in subsection 5.2.2.2.

quantified formula. This change effectively equates updating with Px and $\exists xPx$, as both lead to the same outcome.

(1) $\langle r,G\rangle[Px] =$ I. $\langle r+\langle_n x\rangle, G[P_n x]\rangle$ if $x\notin r$

II. $\langle r, G[P_n x]\rangle\}$ if $\exists n: \langle_n x\rangle \in r$

In case x is not yet in the referent system at the time of the update, this rule ensures the introduction of a new peg: $r+\langle\ _n x\ \rangle$. $G[Px]$ is the set of all assignments g such that g is in G and g assigns a value in the extension of P to the peg n, and indirectly to the variable x. If x is already in the referent system, no addition is necessary; it is only the value that is altered: $G(Px)$ eliminates all possibilities that would falsify Px (i.e. when the object associated with x via the peg is not in the extension of P). Updating with $\exists xPx$ results in the same kind of change in the information state:

(2) $\langle r,G\rangle[\exists xPx] =$ I. $\langle r+\langle\ _n x\ \rangle, G[Px]\rangle$ (where n is the next number) if $x\notin r$;

II. $\langle r, G[Px]\rangle$ if $x\in r$

As for the definitions of conjunction—a sequential update—and implication, they do not differ from either those in 1991 DPL or in its 1996 combination with Veltman's Default in Update Semantics.

(3) $\langle r,G\rangle[\varphi \wedge \Psi] = \langle r,G\rangle[\varphi][\Psi]^{49}$

(4) $\langle r,G\rangle[\varphi \rightarrow \Psi] = \langle r,$ {$g\in G$: for all g' such that $g'\in G'$, where $\langle r',G'\rangle=\langle r,\{g\}\rangle[\varphi]$,

G'' is nonempty, where $\langle r,G''\rangle=\langle r,\{g'\}\rangle[\Psi]\}\rangle$

As updates with expressions containing anaphoric reference are exactly the same processes (as can be seen from (1) and (2)), the conditional works in the same way as it does in DPL, thus ensuring that the following DPL equivalence holds regardless of the modifications:

$$\exists xPx \rightarrow Qx \Leftrightarrow \forall x(Px \rightarrow Qx)$$

---

[49] In the Coreference and Modality version of DPL, this update was partial; here it is not.

From (1) and (2), the following equivalence also holds in this system:

$$Px \rightarrow \exists xQx \Leftrightarrow \exists xPx \rightarrow Qx$$

While this route results in successful updates when cataphoras are involved, the problem is that it overgeneralizes. In the 1996 framework, updating a state with $[\exists xPx]$, where formerly $x \in r$, results in the overriding of the former values of x. In this new approach, every occurrence of x is associated with the same peg, therefore the same object in the discourse, which may be counterintuitive from a strictly logical point of view; however, if one takes natural language discourse into consideration, it is possible to claim that uniqueness is a requirement in a given domain and it is "particular to the context" (Kearns, 2011, p. 68).

5.2.2.2 Route Two: Variable-in-Waiting

The second solution proposes the idea of *variable-in-waiting*, which allows variables to be unbound, and at the same time to introduce an interim peg into the referent system, which is—although a discourse referent—kept separately from the active pegs. The function of an interim peg is to keep track of the variables and the values attributed to them until the reference of the variable is fixed by the introduction of a traditional peg.

Rules of update are as follows[50]:

(1) $\langle r,G \rangle[Px]$ =   I. $\langle r + \langle_A x \rangle, G[P_A x] \rangle$ if $x \notin r$;

                                   II. $\langle r, G[Px] \rangle$ if $\langle_A x \rangle \in r$;

                                   III. $\langle r, G[Px] \rangle \}$ if $\langle_n x \rangle \in r$

(2) $\langle r,G \rangle[\exists xPx]$ =   I. $\langle r + \langle_n x \rangle, G[P_n x] \rangle$ if $x \notin r$

                                   II. $\langle r - \langle_A x \rangle + \langle_n x \rangle, G[Px] \rangle$ if $\langle_A x \rangle \in r$

                                   III. $\langle r - \langle_n x \rangle + \langle_m x \rangle, G[Px] \rangle \}$ if $\langle_n x \rangle \in r$

---

[50] Note: $\langle r - \langle_A x \rangle + \langle_n x \rangle, G(Px) \rangle$ and $\langle r - \langle_n x \rangle + \langle_m x \rangle, G(Px) \rangle$ may be shortened to $\langle r - \langle_{n/A} x \rangle, G(Px) \rangle$ and $\langle r - \langle_{m/n} x \rangle, G(Px) \rangle$ respectively.

That is, in (1), if there is no x in the referent system (I.), then an interim peg A (where A is the next free letter in line) associated with x is introduced, and $\langle r, G \rangle$ pairs in which $P(x)$ is not true are eliminated. If there already is an interim peg (II.), the referent system remains intact, and there are as many possibilities remaining in the updated information state, as objects with property P. Similarly for 1/III, where $\langle {}_n x \rangle \in r$, which is the classic case of updating an information state with an atomic formula in DPL. In (2), update happens with an existential quantifier involved, which normally means that a new peg is to be introduced. This is what happens in I. where x was not in the referent system prior to the update. In II., where an interim peg was already in the referent system, the variable is linked to a new active peg. In case there was an active peg, $\langle {}_n x \rangle$ in r (III.), the referent system deletes that link and instead links the variable to a new peg, $\langle {}_m x \rangle$. In all three cases, the resulting possibilities only include objects with property P.

It is when one considers conjunction and implication involving cataphors that the introduction of interim pegs really shows the difference between the present system and those upon which it is based, even though the rules of both conjunction and implication remain unaltered. Conjunction is both internally and externally dynamic, and implication is internally dynamic. The difference therefore is rooted solely in definitions (1) and (2), as they allow for cataphors (semantically free variables) to be assigned value prior to being associated with a fixed peg, and thus an object. It is an important feature of the modified framework that these values do not disappear with the incoming fixed peg (introduced by an indefinite NP antecedent, for instance) that would—without the proposed modification—override all former values and associations.

Updating with a conditional results in a universal reading—as it does in the 1996 version of DPL. In both $Px \rightarrow \exists x Q x$ and $\exists x P x \rightarrow Q x$, update when x was not originally in the referent system results in the introduction of a new active peg $r +_n x$ and restriction to

possibilities containing objects with the qualities of *P* and *Q*. When there is an interim peg

($_Ax$) in the referent system, it is replaced by a fixed peg, while the resulting information state

is still one where *x* is in the extension of both *P* and *Q*. When there is a fixed peg in the initial

information state, it is, as it was with interim pegs, replaced with a new fixed peg with *Px* and

Qx being true in each resulting state. In essence, therefore, the updates result in the same

information states, as expected. It should, again, be emphasized that these results follow

directly from the definitions in (1) and (2).

5.2.2.3 Sample Analyses

In what follows, two sentences of natural language containing cataphoras are analyzed

first with the route one modification of *no free occurrences*, then with the route two

modification of *variable-in-waiting*. Unfortunately, the most faithful translation of the

sentences leads to updates with formulas that the present system is not yet able to handle;

therefore, the analyses here are of simplified versions of the original sentences. A sentence of

the form "If it is overcooked, a burger tastes bad." is simplified to a form $Px \rightarrow \exists xQx$, and a

sequence of sentences of the form "It was ugly. It was dirty. A cheap hostel is a bad choice."

to $Px \land \exists xQx$. Details of important equivalences follow the analyses.

(1)$Px \rightarrow \exists xQx$

1.a   No free occurrences

$\langle r,G \rangle[Px \rightarrow \exists xQx] =$

$= \langle r,\{g \in G: \forall g' : g' \in G',$ where $\langle r',G' \rangle=\langle r,\{g\} \rangle[Px],$

G'' is nonempty, where $\langle r,G'' \rangle=\langle r,\{g'\} \rangle[\exists xQx]\} \rangle$

    I.   if $x \notin r$:

        $= \langle r,\{g \in G:$ if $g \in G[n][Pn],$ then G'' is nonempty,

        where $\langle r\langle _nx \rangle,G'' \rangle=\langle r+_nx,\{g\} \rangle[\exists xQx]\} \rangle \ =$

        $= \langle r,\{g \in G:$ if $g \in G[Pn],$ then$\{g\}[Qn]$ is nonempty$\} \rangle$

II.   if $x \in r$:

$= \langle r, \{g \in G$: if $g \in G[Pn]$, then G'' is nonempty,

where $\langle r, G'' \rangle = \langle r, \{g\} \rangle [\exists x Qx] \} \rangle =$

$= \langle r, \{g \in G$: if $g \in G[Pn$ $]$, then $\{g\}[Qn]$ is nonempty$\} \rangle$

1.b   *Variable-in-waiting*

$\langle r, G \rangle [Px \rightarrow \exists x Qx] =$

$= \langle r, \{g \in G: \forall g' : g' \in G'$, where $\langle r', G' \rangle = \langle r, \{g\} \rangle [Px]$,

G'' is nonempty, where $\langle r, G'' \rangle = \langle r, \{g'\} \rangle [\exists x Qx] \} \rangle$

I.   if $x \notin r$

$= \langle r, \{g \in G$: if $g \in G[A][PA]$, then G'' is nonempty,

where $\langle r \langle _{n/A} x \rangle, G'' \rangle = \langle r +_A x, \{g\} \rangle [\exists x Qx] \} \rangle =$

$= \langle r, \{g \in G$: if $g \in G[Pn]$, then $\{g\}[Qn]$ is nonempty$\} \rangle$

II.   if $_A x \in r$

$= \langle r, \{g \in G$: if $g \in G[P_A x]$, then G'' is nonempty,

where $\langle r \langle _{n/A} x \rangle, G'' \rangle = \langle r, \{g\} \rangle [\exists x Qx] \} \rangle =$

$= \langle r, \{g \in G$: if $g \in G[Pn]$, then $\{g\}[Qn]$ is nonempty$\} \rangle$

III.   if $_n x \in r$

$= \langle r, \{g \in G$: if $g \in G[P_n x]$, then G'' is nonempty

where $\langle r \langle _{m/n} x \rangle, G'' \rangle = \langle r, \{g\} \rangle [\exists x Qx] \} \rangle =$

$= \langle r, \{g \in G$: if $g \in G[Pm$ $]$, then $\{g\}[Qm]$ is nonempty$\} \rangle$

(2)*Px* ∧ ∃*xQx*

2.a No free occurrences

⟨*r,G*⟩[*Px* ∧ ∃*xQx*] = ⟨*r, G*⟩[*Px*][∃*xQx*] =

    I.   if $x \notin r$

              = ⟨*r* + $_n$*x, G* [*n*][*Pn*]⟩[∃*xQx*] =

              = ⟨*r* + $_n$*x, G*[*n*][*Pn*][*Qn*]⟩

    II.   if $_n x \in r$

              = ⟨*r, G*[*Pn*]⟩[∃*xQx*] =

              = ⟨*r, G*[*Pn*][*Qn*]⟩

2.b Variable-in-waiting

⟨*r, G*⟩[*Px* ∧ ∃*xQx*] = ⟨*r, G*⟩[*Px*][∃*xQx*]

    I.   if $x \notin r$

              = ⟨*r* + $_A$*x, G* [*A*][*PA*]⟩[∃*xQx*] =

              = ⟨*r* + $_A$*x* + $_{n/A}$*x, G*[*n*][*Pn*][*Qn*]⟩ =

              = ⟨*r* + $_n$*x, G*[*n*][*Pn*][*Qn*]

    II.   if $_A x \in r$

              = ⟨*r, G*[*PA*]⟩[∃*xQx*] =

              = ⟨*r* + $_{n/A}$*x, G*[*Pn*][*n*][*Qn*]⟩

    III.   if $_n x \in r$

              = ⟨*r, G*[*Pn*]⟩[∃*xQx*] =

              = ⟨*r* + $_{m/n}$*x, G*[*Pm*][*m*][*Qm*]⟩

Equivalences:

1.b/I. is the relevant situation for cataphors, thus equivalence with the other two scenarios, where x is already in the referent system (either via an interim peg, or via an active peg), need not be detailed here. The same is true when updating with $\exists x Px \wedge Qx$, where 2.b/I. is the relevant situation. Also, in route one (no free occurrences), the equivalences follow from the update rules for $\exists x Px$ and Px.

(3) $Px \rightarrow \exists x Qx \Leftrightarrow \exists x Px \rightarrow Qx$ $(\Leftrightarrow_{DPL} \forall x (Px \rightarrow Qx))$

$\langle r, G \rangle [\exists x Px \rightarrow Qx] =$

$= \langle r, \{ g \in G : \forall g' : g' \in G', \text{ where } \langle r', G' \rangle = \langle r, \{ g \} \rangle [\exists x Px],$

G'' is nonempty, where $\langle r, G'' \rangle = \langle r, \{ g' \} \rangle [Qx] \} \rangle =$

if $x \notin r$

$\quad = \langle r, \{ g \in G : \text{ if } g \in G[n][\exists x Pn], \text{ then } G'' \text{ is nonempty},$

$\quad \text{where } \langle r \langle_n x \rangle, G'' \rangle = \langle r +_n x, \{ g \} \rangle [Qx] \} \rangle =$

$\quad = \langle r, \{ g \in G : \text{ if } g \in G[Pn], \text{ then} \{ g \}[Qn] \text{ is nonempty} \} \rangle$

(4) $Px \wedge \exists x Qx \Leftrightarrow \exists x Px \wedge Qx$ $(\Leftrightarrow_{DPL} \exists x Px \wedge Qx)$

$\langle r, G \rangle [\exists x Px \wedge Qx] = \langle r, G \rangle [\exists x Px][Qx] =$

if $x \notin r$

$\quad = \langle r +_n x, G [n][Pn] \rangle [Qx] =$

$\quad = \langle r +_n x, G[n][Pn][Qn] \rangle$

5.2.3 Concluding remarks

The advantages of the modifications is that they accommodate interpretation in situ; that is, no movement is involved, and cataphors still receive the interpretation they can at the point at which they are introduced. Furthermore, their contribution to the whole, the value the

peg (actual peg in *no free occurrences*, interim peg in *variable-in-waiting*) assigns them indirectly, is preserved and is accessible for the next update to go through. In the case of the *variable-in-waiting* modification, the resulting information state can be updated again in the usual way (with the additional rules that the handling of interim pegs require). The *no free occurrence* modification brings about a more fundamental change (as discussed at the very end of subsection 5.2.2.2).

It is true in both route one and route two that updates cannot come to a halt when there are formerly unintroduced variables in the formula one updates with. In "Coreference and Modality" (1996), this is not so. Therefore, the present suggestions pave the way for an analysis that reflects natural language discourse more accurately, where information processing does not stop upon encountering a pronoun of unknown reference. As subsection 5.1 hopes to show, in such situations, an *active prospective search* begins for an antecedent. The reflection of this in semantics is what the modifications aspire to achieve.

The following reasons make route two superior to route one. In route one, it is not possible to override the associations between pegs and variables. That is, in a sequence such as $\exists xPx \ldots Qx \ldots \exists xSx,$ updating with the second existentially quantified formula cannot result in the introduction of a new peg, as it happens in the 1996 version of DPL. In natural language discourse, however, it is not uncommon for this to happen. Therefore, the update rule (2/III) in route two is more successful in this respect, as the active peg ($_nx$) of the first update $\exists xPx$ is replaced by a new active peg ($_mx$) (where m designates the next available number) by updating with $\exists xSx$. Furthermore, in route one, the equivalence of $Px \rightarrow \exists xQx \Leftrightarrow \exists xPx \rightarrow Qx$ holds, which is not desirable in light of the update issues just discussed. In route two, on the other hand, this equivalence only holds when x is not associated with an active peg prior to the first update, which is exactly what cataphoric structures are presumed to be like.

It should be noted that this treatment of cataphors makes no distinction between "semantic" and "pragmatic" occurrences. As it is in the 1991 and 1996 versions of DPL, syntactic binding is not a necessary condition for semantic binding. Therefore, examples that some would consider cases of coreference only (such as *It was ugly. It was dirty. A cheap hostel is a bad choice.,* which is a somewhat complicated and controversial case of coreference considering the status of indefinite noun phrases in semantics) are analyzed the same as cases of "binding proper" (such as *If it is overcooked, a burger always tastes bad*.). While less reliant on syntax, this framework does take natural language use and information processing into account. The *variable-in-waiting* approach allows for a relatively accurate semantic representation of *active prospective search*, albeit it does not operate with syntactic constraints in mind.

In this sense, this modified version of DPL with referent systems (for lack of a better term) is more autonomous and is at the same time closer to providing interpretation for a surface representation than some of the other dynamic semantic frameworks are (such as Dynamic Binding (Chierchia, 1995)). For this reason, the modifications proposed in this section are an important step to an accurate dynamic semantic representation of a hearer's interpretation of cataphoric structures in natural language discourse.

Further research could propose an account of cataphors as *variables-in-waiting* with R-expression antecedents, such as proper names and definite descriptions, which are generally translated as individual constants in the logical language.

The new system could also be extended in a way as to handle cataphors with indefinite noun phrase antecedents that express generalizations—the types of examples simplified in the present analysis.

6. Conclusion

The purpose of this study was to remove cataphors from the realm of neglect and provide an analysis that paves the way for a place in semantics, more specifically in dynamic semantics. It was important to first show the context in which cataphors appear, as one's theoretical standing on matters of the syntax-semantics interface and on the semantics-pragmatics interface can significantly influence the analysis of cataphors. The present study concludes that there need not be a semantic difference between instances of cataphors formerly thought of as "semantic" and "pragmatic", therefore, both (former) types are treated the same. It was also important to provide an alternative to those analyses that handle cataphors as hidden anaphors (such as DRT, and Dynamic Binding). The last section of this study thus proposes two new ways of analyzing structures with cataphors, both of which are compatible with a DPL framework. The two alternatives were (1) prohibiting semantically free variables, and (2) introducing interim pegs as transient objects with which syntactically free variables can be associated. The study concludes by arguing for the latter alternative, which—although a simple change in the system—provides a more refined analysis that has the ability to account for cataphoric structures without changing the order of the cataphor-antecedent sequence, thus representing more closely the hearer's interpretation of cataphors in natural language discourse.

References

Bianchi, V. (2010). A note on backward anaphora. Universitá di Sienna.

Retrieved from: http://www.academia.edu/3890595/A_note_on_backward_anaphora

Bruti, S. (2004) Cataphoric complexity in spoken English. In K. Aijmer & A. Stenström (Eds.), *Discourse Patterns in Spoken and Written Corpora* (pp. 39-63). Amsterdam: John Benjamin Publishing Company.

Cann, R. & McPherson, C. (1999). Interclausal cataphora in English. Unpublished MS, University of Edinburgh.

Retrieved form: http://www.ling.ed.ac.uk/~ronnie/cat99-pretty.doc

Carden, G. (1982.) Backwards Anaphora in Discourse Context. *Journal of Linguistics*, 18(2). 361-387. Retrieved from http://www.jstor.org/stable/4175643

Chierchia, G. (1995). *Dynamics of Meaning: Anaphora, Presupposition, and the Theory of Meaning.* Chicago, IL: The University of Chicago Press

Geurts, B., Beaver, D. I., Maier, E. (2016) Discourse Representation Theory. *The Stanford Encyclopedia of Philosophy* (Spring 2016 Edition), Edward N. Zalta (ed.), forthcoming Retrieved from http://plato.stanford.edu/archives/spr2016/entries/discourse-representation-theory/

Groenendijk, J. & Stokhof, M. (1991). Dynamic Predicate Logic. *Linguistics and Philosophy*, 14(1), 39-100.

Retrieved from: http://humanities.uva.nl/~stokhof/Papers/dpl.pdf

Groenendijk, J., Stokhof, M., Veltman, F. (1996). Coreference and Modality. In: S. Lappin (ed), *Handbook of Contemporary Semantic Theory*,Oxford, UK: Blackwell

Retrieved form: http://humanities.uva.nl/~stokhof/Papers/cm.pdf

Hinzen, W., Werning, M, & Machery, E. (2012). Introduction. In W. Hinzen, M. Werning, & E. Machery (Eds.), *The Oxford Handbook of Compositionality* (pp. 1-16). Oxford, UK: Oxford University Press.

Jacobson, P. (2014). *Compositional Semantics: An Introduction to the Syntax/Semantics Interface.* Oxford, UK: Oxford University Press

Janssen, T. M. V. (1997). Compositionality. In J. van Benthem & A. ter Meulen (Eds.), *Handbook of Logic and Language* (pp. 417-473). Cambridge, MA: The MIT Press.

Kazanina, N., Lau, E.F., Lieberman, M., Yoshida, M., Phillips, C. (2007). The effect of syntactic constraints on the processing of backwards anaphora. *Journal of Memory and Language*, 56, 384-409.

Retrieved from: http://ling.umd.edu/~colin/research/papers/kazanina2007-jml.pdf

Kearns, Kate. (2011). *Semantics*. UK: Palgrave Macmillan

King, J. C. (2013). Anaphora. *The Stanford Encyclopedia of Philosophy* (Summer 2013 Edition), Edward N. Zalta (ed.),

Retrieved from http://plato.stanford.edu/archives/sum2013/entries/anaphora/

Rowling, J. K. (1999). Harry Potter and the Prisoner of Azkaban. London, UK: Bloomsbury

Lasnik, H. & Uriagereka, J. (2005). LF Processes. Why We (Don't?) Need Them and What They Might Be. In *A Course in Minimalist Syntax* (pp. 180-222). Oxford: Blackwell

Lohndal, T. (2014). *Phrase Structure and Argument Structure: A case study of the Syntax-Semantics Interface.* Oxford, UK: Oxford University Press

Lycan, W. G. (2000). *Philosophy of Language: A Contemporary Introduction*. (2nd ed.) New York, NY: Routledge

May, R. (1985). *Logical Form: Its Structure and Derivation*. Cambridge, MA: The MIT Press

Minkoff, S. A. (2004) Consciousness, Backward Coreference, and Logophoricity. *Linguistic Inquiry*, 35(3). pp. 485-494. Retrieved from http://www.jstor.org/stable/4179288

Newson, M. (2014). 12a Binding [class handout]. Department of Linguistics, Eötvös Loránd

   University, Budapest.

   Retrieved from: http://seas3.elte.hu/coursematerial/NewsonMark/12a_Binding.docx

Partee, B. H. (2004). *Compositionality in formal semantics.* Malden, MA: Blackwell

   Publishing Ltd.

Partee, B. H. (2008). Lecture 5. Introduction to Issues in Anaphora [class handout]. RGGU,

   Moscow.

   Retrieved from: http://people.umass.edu/partee/RGGU_2008/RGGU085_2up.pdf

Stojanovic, I. (2008). The semantics/pragmatics distinction. *Synthese*, *165*(3), 317–319.

   Retreived from http://www.jstor.org/stable/40271118

Thomas, J. (1995). *Meaning in Interaction*. Essex, England: Longman Group Limited.

van Eijck, J. & Kamp, H. (1997). Representing Discourse in Context. In J. van Benthem & A.

   ter Meulen (Eds.), *Handbook of Logic and Language* (pp. 179-237). Cambridge, MA:

   The MIT Press

Veltman, F. (1996). Defaults in Update Semantics. *Journal of Philosophical Logic*, 25(3),

   222-261. Retrieved from http://www.jstor.org/stable/30226572

Westerståhl, D. (2011). Generalized Quantifiers. The Stanford Encyclopedia of Philosophy

   (Summer 2015 Edition), Edward N. Zalta (ed.), Retreived from

   http://plato.stanford.edu/archives/sum2015/entries/generalized-quantifiers/